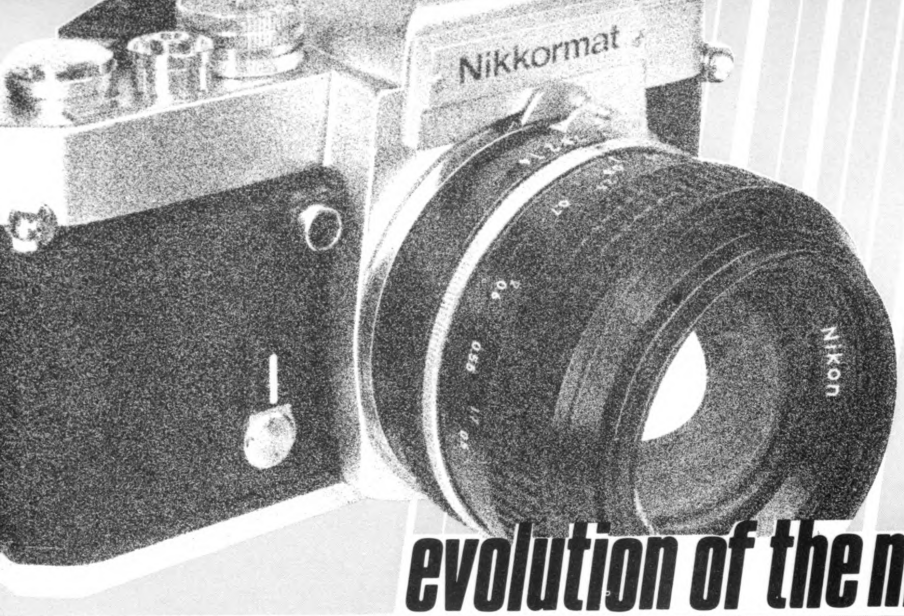


evolution of the nikkormat el

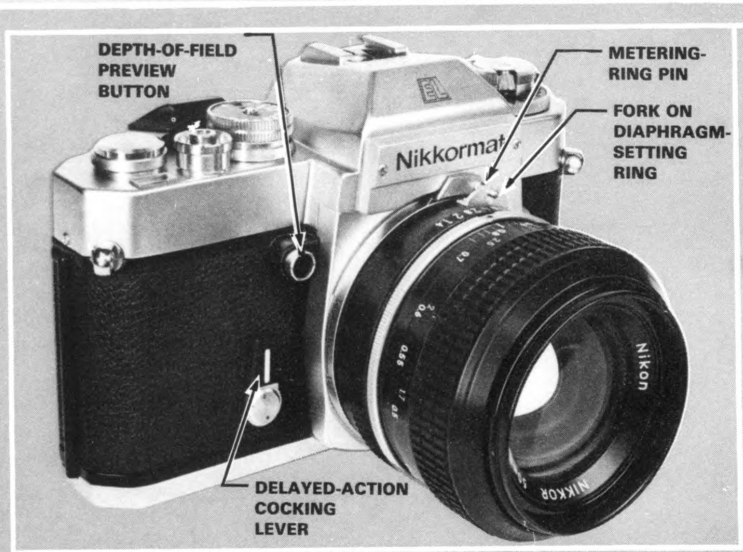


Figure 1



Figure 2

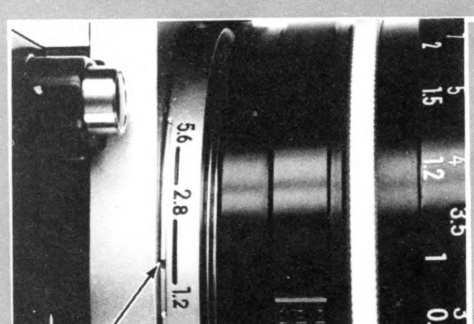




Figure 4 Indicator in the semiautomatic-indexing system

by Larry Lyells



Figure 3 The Nikon FE, a tiny spinoff of the Nikkormat EL



Figure 5 Automatic-indexing system in the Nikon FE

CHANGES AT NIKON

Some time ago, we promised you an article covering the popular Nikkormat EL. Since then, there've been some significant changes at Nikon -- changes you can credit to the EL's success.

The EL was the first Nikon or Nikkormat camera to feature fully automatic exposure control. Now Nikon has quite an array of fully automatic SLR's. The new SLR's wear the prestigious "Nikon" (rather than the "Nikkormat") nameplate, indicating that Nikon has granted full status to the automatic camera.

A modified Nikkormat EL, the EL2, became the first automatic camera with the Nikon nameplate. Another offspring, the ELW, is simply an EL that's been modified to accept a motor drive. And now there's a miniature version of the camera -- the tiny Nikon FE, Fig. 3.

The new generation of Nikon SLR's features a major modification to the traditional Nikkor lens design. Nikon calls its new Nikkor series the AI (for "automatic indexing") lenses.

Automatic indexing eliminates what has become popularly known as the "Nikon shuffle." With the earlier semiautomatic-indexing style, you must remove and replace the lens at the f/5.6 setting. When you install the lens, you must capture the pin of the metering ring, Fig. 1, within the fork on the diaphragm-setting ring.

Then comes the shuffle. First turn the diaphragm-setting ring fully to the smallest f/stop; next turn the diaphragm-setting ring fully to the largest f/stop. The shuffle mechanically indexes the metering system for the maximum lens aperture. An indicator on the side of the lens-mounting ring, Fig. 4, should now show the maximum aperture of the lens you've installed. If the indicator reads correctly, you know that you've properly indexed the system.

What's different in the AI lenses? Each AI lens has a metering-coupling ridge which comes against a sensing lever in an automatic-indexing camera. The position of the ridge varies according to the maximum aperture. So, when you install the lens, the ridge automatically provides the maximum-aperture information needed by the exposure-meter system. No more shuffle.

Yet you can use the AI lenses on semiautomatic-indexing models like the EL. The AI lens retains the fork on the diaphragm-setting ring (even though the fork has no application in an automatic-indexing camera). To index the AI lens to an earlier camera, use the semiautomatic-indexing procedure.

You can also use the semiautomatic-indexing lenses on the new Nikons. But you must then take your meter reading through a stopped-down aperture. Many people who already own a Nikkor lens system have purchased one of the new AI cameras. They may then want their lenses modified to provide automatic indexing.

Perhaps you've received requests for such modifications. However, making the modification is a major job. Nikon does have kits which contain what you need to adapt older lenses for the AI system. But Nikon tells us that the kits are in limited supply. So, at least for the present time, you'll probably have to send modifications to EPOI.

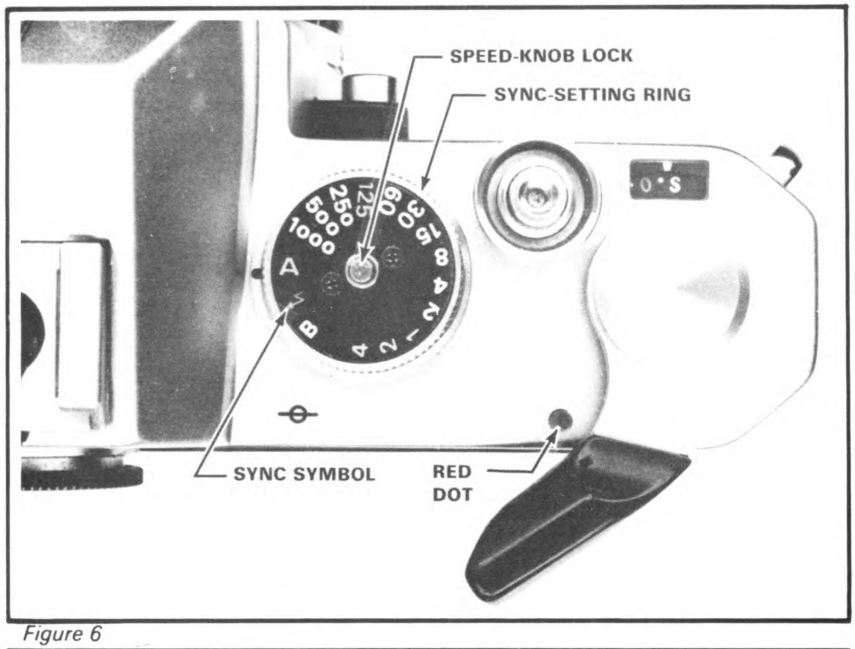


Figure 6

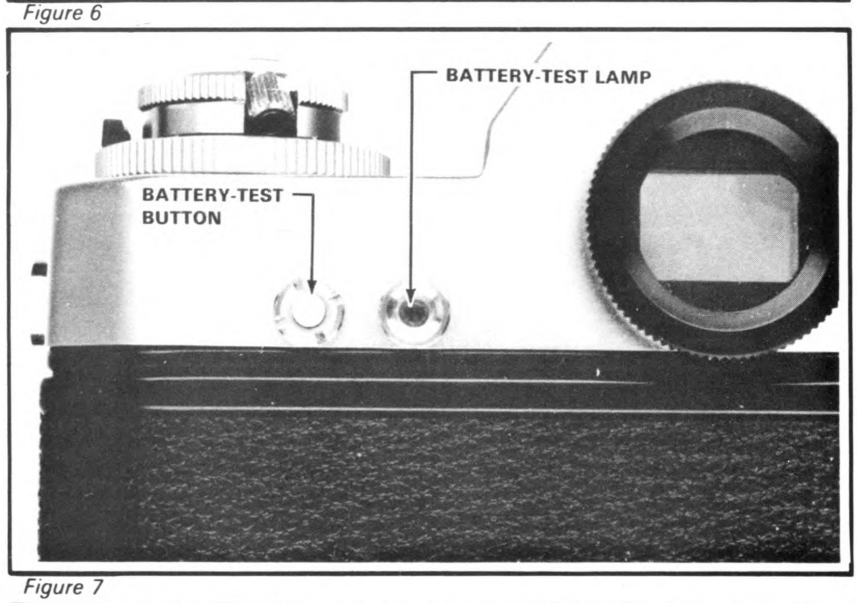


Figure 7

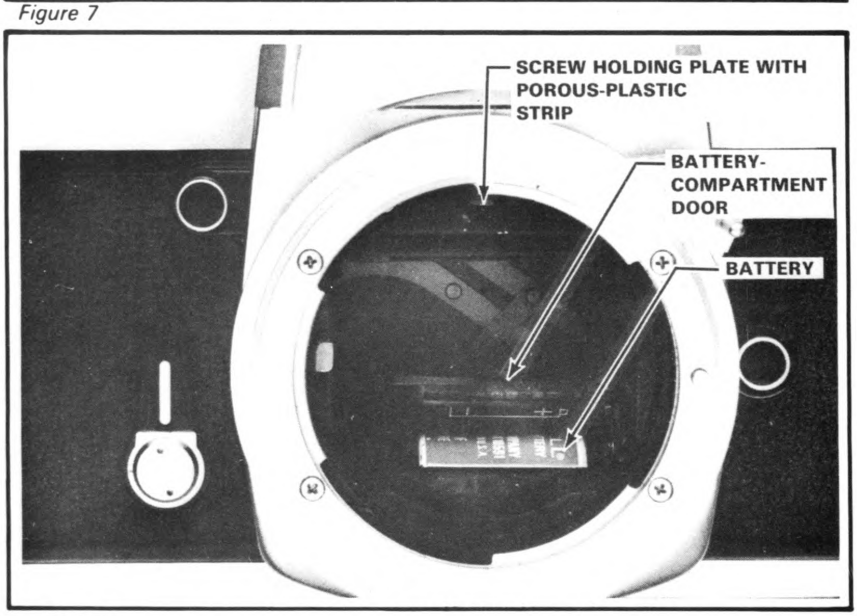


Figure 8

EXTERNAL TESTS ON THE EL

The EL's relatively long record of field service allows us to point out some of the common repairs you'll encounter. You can often isolate the problem area without even taking apart the camera.

Many of the more common malfunctions result directly from owner abuse. Suppose, for example, that your customer complains of excessive battery drain. If the rest of the camera works properly, suspect a problem in the wind-lever switch. The wind-lever switch both turns on the exposure meter and serves as the master switch for the rest of the system.

Moving the wind lever to the ready position, Fig. 6, closes the wind-lever switch. Notice in Fig. 6 that the wind lever now uncovers a red dot, indicating that you've turned on the meter. Returning the wind lever to the storage position opens the wind-lever switch and simultaneously locks the release button.

Why lock the release button? Because none of the electronic systems will work with the wind-lever switch turned off. Yet the wind-lever switch may be remaining in the on position, causing the battery drain.

To quickly check the wind-lever switch, select a 4-second exposure -- just depress the speed-knob lock, Fig. 6, to set one of the manual shutter speeds. Now cock the shutter and push the release button. While the shutter's open, push the wind lever to the storage position; that should open the wind-lever switch and cause the shutter to close. But if the shutter proceeds to time out the 4-second exposure, there's most likely a problem with the wind-lever switch.

You might also check the latching action of the release button. A latch moves under the release button when you push the wind lever to the storage position. If you locate a problem with the wind-lever switch, you may find that the release button fails to latch.

There's another latch that may fail as a result of abuse -- the speed-knob lock. The speed knob should latch at the automatic setting. You may find, however, that you can turn the speed knob to the manual settings without depressing the speed-knob lock, Fig. 6.

Chances are the owner has forced the speed knob to a manual setting without depressing the speed-knob lock. Fortunately, a defective lock doesn't affect the operation. And the owner may prefer to do without the speed-knob lock. Nikon supplies most of the parts in the speed-selector assembly as a complete unit; there are very few speed-selector parts you can obtain individually.

The speed-selector assembly also includes the flash-sync control. Since the EL has a Copal Square shutter, you can use electronic flash at the 1/125-second setting (actually, 1/100 second as with other Copal Square shutters). To select the sync delay, lift and turn the outer ring of the speed knob, Fig. 6. A symbol visible through the shutter-speed calibration plate indicates the sync setting -- a lightning-flash symbol for X sync and a flashbulb symbol for FP sync.

Notice that the film-speed selector sits at the other end of the camera -- under the rewind knob, Fig. 2. To set the film speed, first depress the silver-colored film-speed latch. The film-speed latch locks the film-speed dial at the selected setting.

Another latch locks the rewind knob. To lift the rewind knob and open the camera back, you must first push the rewind-shaft latch, Fig. 2.

From the back, the shutter looks like any other Copal Square. But the EL shutter offers a rather unique advantage. All of the shutter speeds in the EL -- the calibrated speeds as well as the automatically controlled exposures -- are electronically timed. Yet, even if the battery dies, you get an exposure.

The mechanical shutter speed in the EL is around 1/90 - 1/100 second. Without battery power, most electronic Copal Squares give you no exposure at all. But, since the EL gives you the full-aperture speed, you can still use the camera with electronic flash.

You may find that the camera delivers *only* the mechanical speed -- regardless of the speed-knob setting. In that case, first check the battery. Test the battery by pushing the battery-test button at the back of the camera, Fig. 7; the battery-test lamp should turn on.

A 6-volt silver-oxide battery (Mallory PX28 or equivalent) powers both the shutter and the exposure-control system. When the EL first came along, people had quite a time locating the battery position. You must first turn the mirror lock-up lever, Fig. 2, to raise the mirror. Then, swing open the battery-compartment door at the bottom of the mirror cage to reach the battery, Fig. 8.

If the battery tests properly -- yet you still get only the mechanical speed -- the camera has an electronic problem. One of the common reasons again results from abuse. Many people aren't content to use their fingers when pushing the battery-test button, Fig. 7. They often use a ball-point pen or a mechanical pencil, putting enough pressure on the battery-test button to cause internal damage.

Enough pressure may cause the battery-test switch to short against the functional resistor. The functional resistor sits under the film-speed dial; turning the film-speed dial rotates the functional resistor to program the film-speed setting. If the battery-test switch shorts to the functional resistor, you'll find that the shutter delivers the mechanical speed at any speed-knob setting.

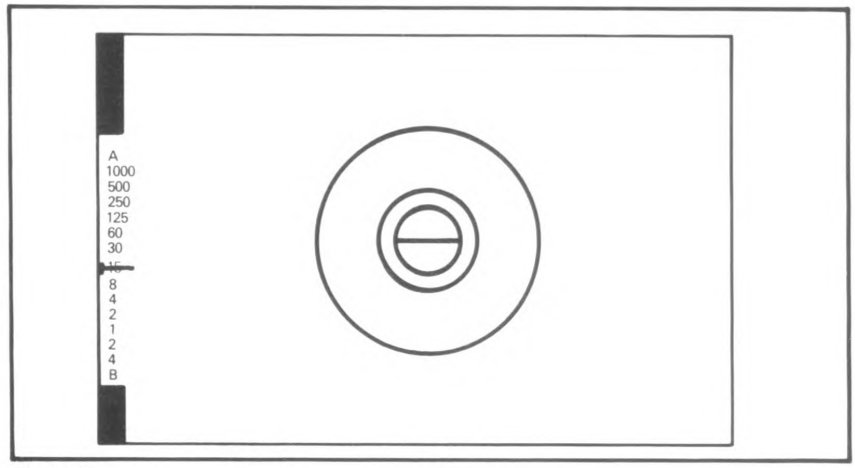


Figure 9

FOCUSING-SCREEN READOUT

The shutter-speed scale visible through the finder, Fig. 9, shows you what shutter speed will be automatically programmed. With the meter turned off, the needle should point to the 1/15-second calibration as shown in Fig. 9. The needle should deflect to the appropriate shutter-speed calibration when you move the wind lever to the ready position.

A green pointer on the scale couples to the speed knob. If you set the speed knob to the automatic setting, the green pointer sits over the "A" on the shutter-speed scale. Turning the speed knob to the manually set speeds moves the green pointer to the appropriate shutter-speed calibration.

The green pointer allows you to see the speed-knob setting without moving your eye from the finder. But it also provides a match-needle mode of operation. Just turn the speed knob until the green pointer centers over the needle. You've then set the proper shutter speed for the light conditions.

We're especially thankful for Nikon's technique in mounting the focusing screen. Cleaning the focusing screen can be a major job in many electronically controlled cameras. Often, there's so much circuitry mounted on top of the pentaprism that removing the focusing screen requires major surgery.

Initially, that also appears to be the situation in the EL. But Nikon provides an easy-access route to the focusing screen. You don't even have to pull the top cover. Simply remove the screw at the top of the mirror cage, Fig. 8.

Now lift out the plate containing the porous-plastic strip, Fig. 8; a tab on the plate passes into a slot in the focusing-screen support. You can then lift out the focusing-screen support, the spring washer, and the focusing screen.

PROGRAMMING THE FILM SPEED AND DIAPHRAGM OPENING

As mentioned earlier, the EL uses a functional resistor to program the film speed and f/stop. In earlier Nikkormat designs, the functional resistor accounts for many of the meter repairs. That's also true in the EL.

How can you spot a problem in the functional resistor? Normally, the needle shoots to the top of the shutter-speed scale when you move the wind lever to the ready position. And the shutter delivers only the mechanical speed when set to automatic.

At the automatic setting, the functional resistor controls the charging time of the timing capacitor. That's how the automatic system senses two of the exposure variables. Changing either the film speed or the f/stop affects the resistance programmed by the functional resistor.

The remaining exposure variable -- the amount of light -- controls the charge on the memory capacitor. Here, the EL gives us a chance to describe the troubleshooting and switch-timing sequence involved with a memory-capacitor system.

MEMORY FEATURES

Many fully automatic SLR's, like the EL, provide two modes of operation. Typically, you have a choice between automatically controlled shutter speeds and manually set shutter speeds.

At the manual speed settings, the speed selector programs a resistance value in series with the timing capacitor,

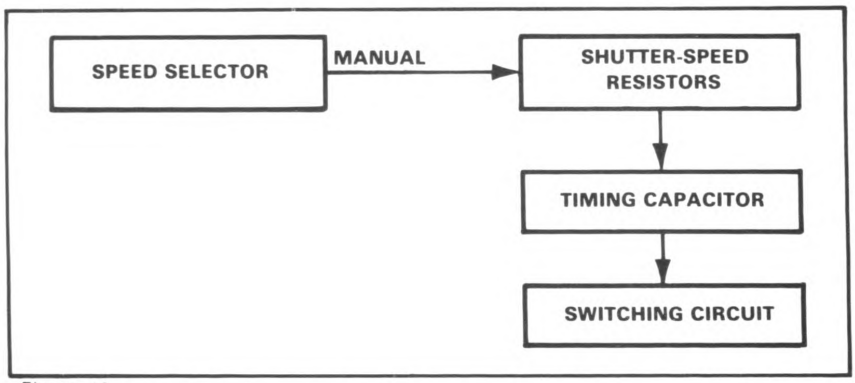


Figure 10

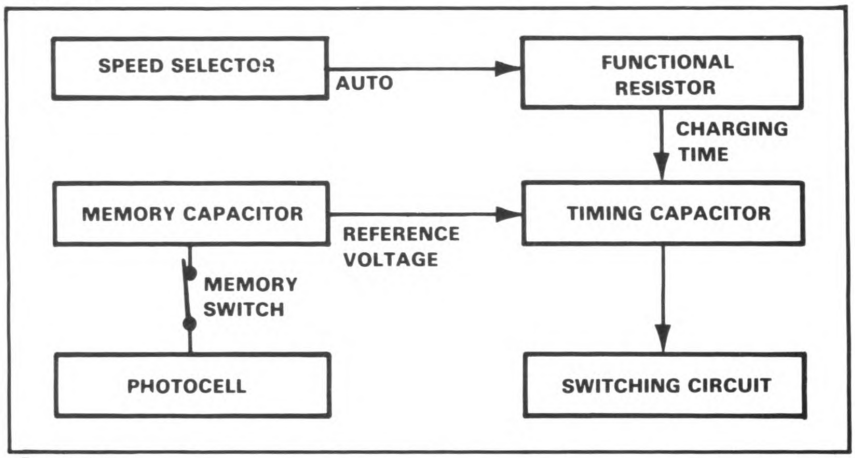


Figure 11

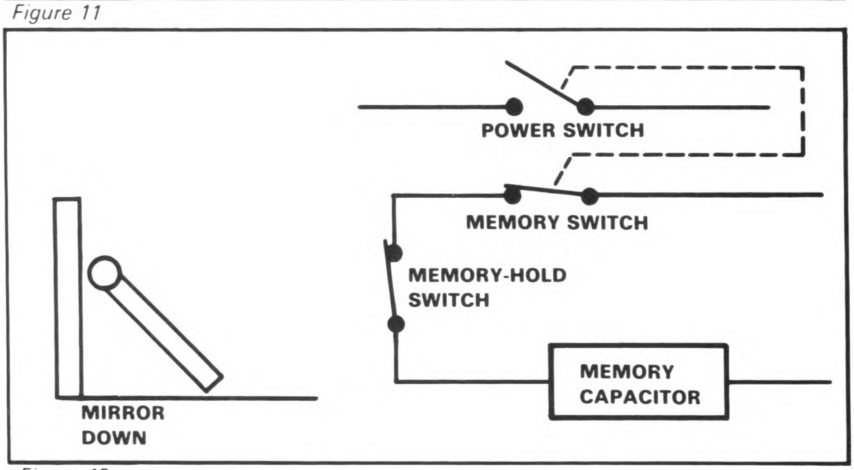


Figure 12

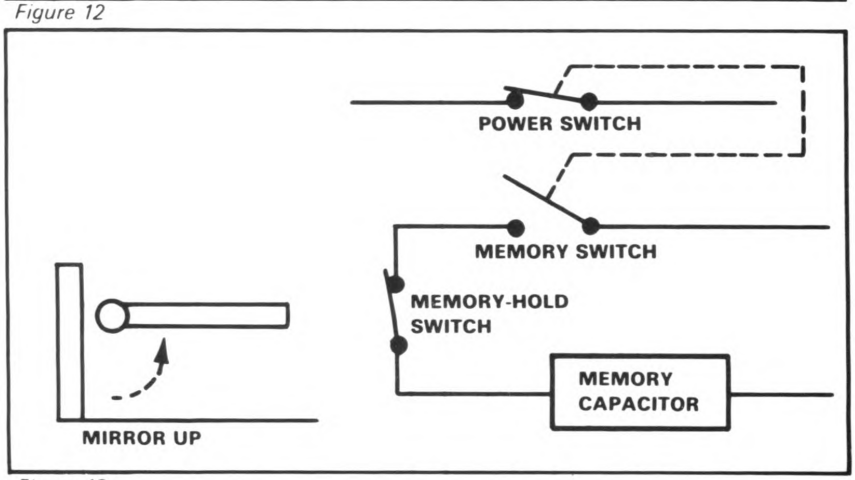


Figure 13

Fig. 10. The resistance value determines how long it takes for the timing capacitor to charge. When the timing capacitor reaches a certain charge, it signals the switching circuit. And the switching circuit shuts off the current flowing through the electromagnet to end the exposure.

Automatically controlled exposures require a different system. The camera must somehow memorize the light level before the mirror starts moving to the taking position. Once the mirror starts its climb, the photocells can no longer see the light coming through the lens.

At auto, the speed selector then disconnects the shutter-speed resistors from the circuit. Instead, it connects a memory capacitor to the control system, Fig. 11.

The photocell now controls the charge on the memory capacitor, Fig. 11. As long as the memory switch remains closed, the memory capacitor can charge according to the light conditions. The brighter the light, the greater the charge on the memory capacitor.

Just before the mirror starts climbing, though, the memory switch opens. That locks in the charge on the memory capacitor -- the memory capacitor thereby memorizes the light conditions. So, even though the photocell can no longer see the light, the last light conditions have been memorized.

The timing capacitor must now charge to the reference voltage stored in the memory capacitor. That takes care of one of the exposure variables, the light conditions. What about the other variables? They're programmed by the functional resistor. The functional resistor, set by the film speed and the f/stop, programs a resistance value into the capacitor-charging system. That resistance value decides how long it takes for the timing capacitor to reach the reference voltage memorized by the memory capacitor.

In a memory-capacitor system, the most frequent problems you encounter involve the memory switch and the memory capacitor. A failure in the memory system affects the operation at the automatic mode. Yet the manually controlled speeds may still work fine.

For example, consider that the memory switch isn't making good contact. The memory capacitor then fails to charge. As a result, the timing circuit thinks you're shooting under a very low light level. And the shutter hangs open on the automatic mode. If the memory capacitor is defective, you'll have the same malfunction.

There's another critical factor -- the timing of the switches which sequence the memory circuit. Fig. 12 shows the switches in the Nikkormat EL. A part of

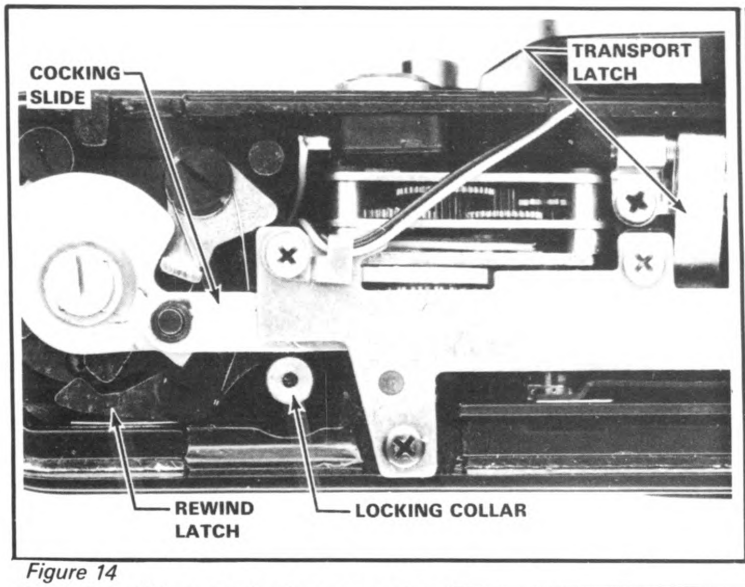


Figure 14

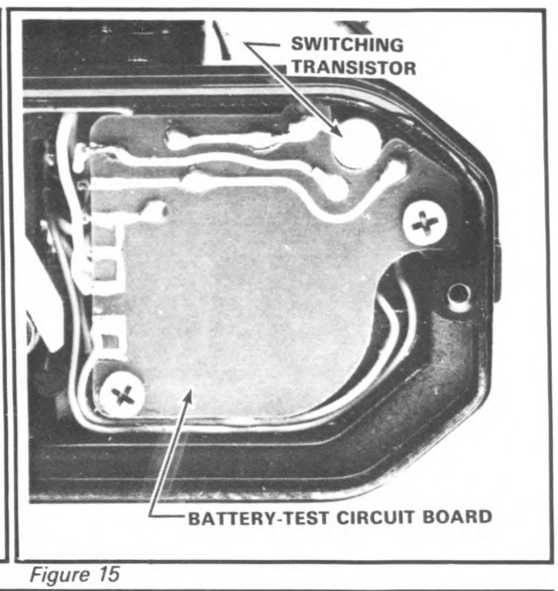


Figure 15

the mirror-lifting mechanism controls both the memory switch and the power switch.

With the mirror in the viewing position, Fig. 12, the power switch remains open. But the memory switch closes, allowing the memory capacitor to charge. The memory capacitor charges as soon as you move the wind lever to the ready position.

Pushing the release button then releases the mirror. Before the mirror starts to rise, the mirror-lifting system closes the power switch; that provides battery power for the timing circuit. Also, the mirror-lifting system opens the memory switch to lock in the light-value information, Fig. 13.

Notice in Fig. 12 and Fig. 13 that you can also open the memory-capacitor circuit with the memory-hold switch. The Nikkormat EL incorporates the memory-hold feature into the delayed-action cocking lever, Fig. 1. Pushing the delayed-action cocking lever toward the lens opens the memory-hold switch.

You can use the memory-hold feature for unusual lighting conditions -- conditions which could fool the automatic system. For example, suppose you have a strongly backlit subject. You can then move close to your subject to take a meter reading. Lock in that exposure reading by pushing the delayed-action cocking lever toward the lens. Then, while still holding in the delayed-action cocking lever, move back to your shooting distance to take the picture.

If you have a problem with any of the switches shown in Fig. 13, you must remove the front-plate/mirror-cage assembly. However, there's very little disassembly required to test and time the switches. You just have to remove the top and bottom covers, as we'll now describe.

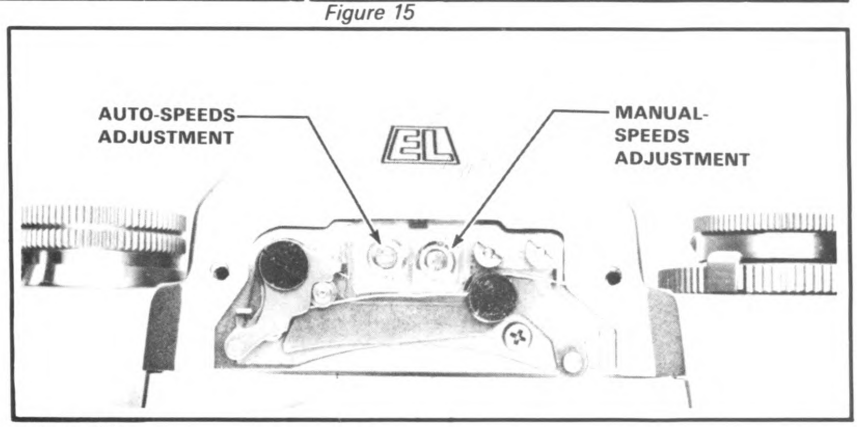


Figure 16

UNDER THE BOTTOM COVER

There's only one precaution in removing the bottom cover -- the locking collar for the rewind will be loose. Fig. 14 shows the locking collar in place; you might lift it out immediately to prevent loss. The rewind button itself remains with the bottom cover.

On reassembly, seat the locking collar over the sprocket rod -- the larger diameter of the locking collar goes down, toward the camera. Then, push the rewind latch, Fig. 14, away from the locking collar. The locking collar should now seat fully.

For the most part, the mechanism at the bottom of the EL looks typically Copal Square. The transport latch, Fig. 14, locks the cocking rack at the end of the cocking cycle. So, until you release the shutter, you can't advance the wind lever a second time.

The mirror-tensioning lever on the mirror cage controls the transport latch. At the end of the exposure, the mirror-tensioning lever kicks the transport latch out of engagement with the cocking rack.

If you're having a problem with the wind stroke, you might first check the transport latch. Sometimes the screws holding the transport latch work loose. You may then find that the transport latch won't disengage properly. And the wind lever remains locked after the release cycle.

The circuit board at the other end of the camera body holds the battery-test components, Fig. 15. In later versions of the EL, the battery-test components mount inside the camera body -- you must remove the front-plate/mirror-cage assembly to reach the battery-test circuit.

REMOVING THE TOP COVER

Take out the two cross-point screws which hold the "Nikkormat" nameplate. Lifting off the nameplate reveals two of the variable-resistor adjustments for the exposure-control system, Fig. 16.

The variable resistor to your left, Fig. 16, provides the adjustment for the automatically controlled shutter speeds. The other variable resistor provides the adjustment for the manually set shutter speeds.

You'll frequently find that the camera only needs a fine tune-up of the adjustments. The variable resistors may be

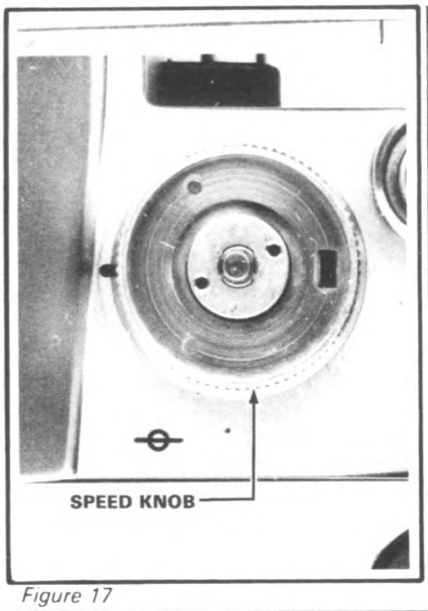


Figure 17

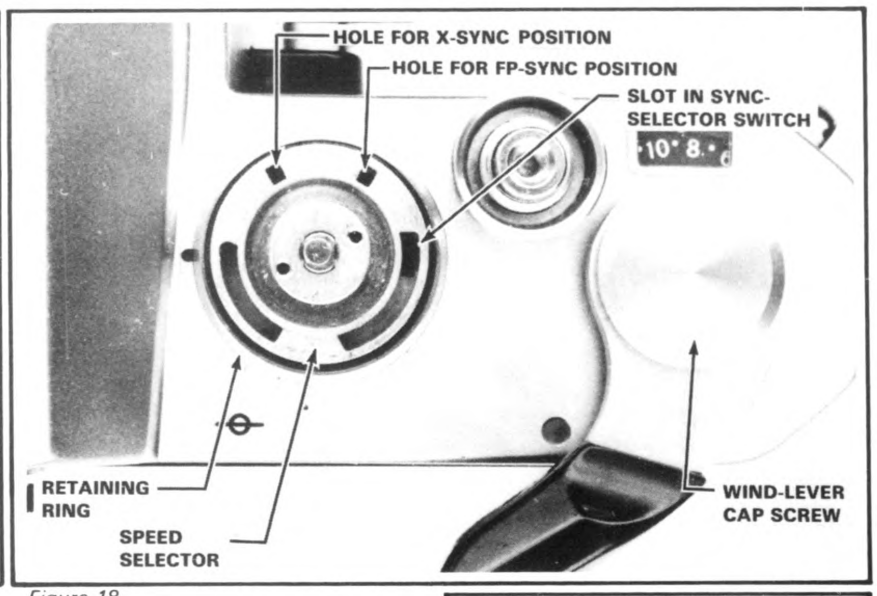


Figure 18

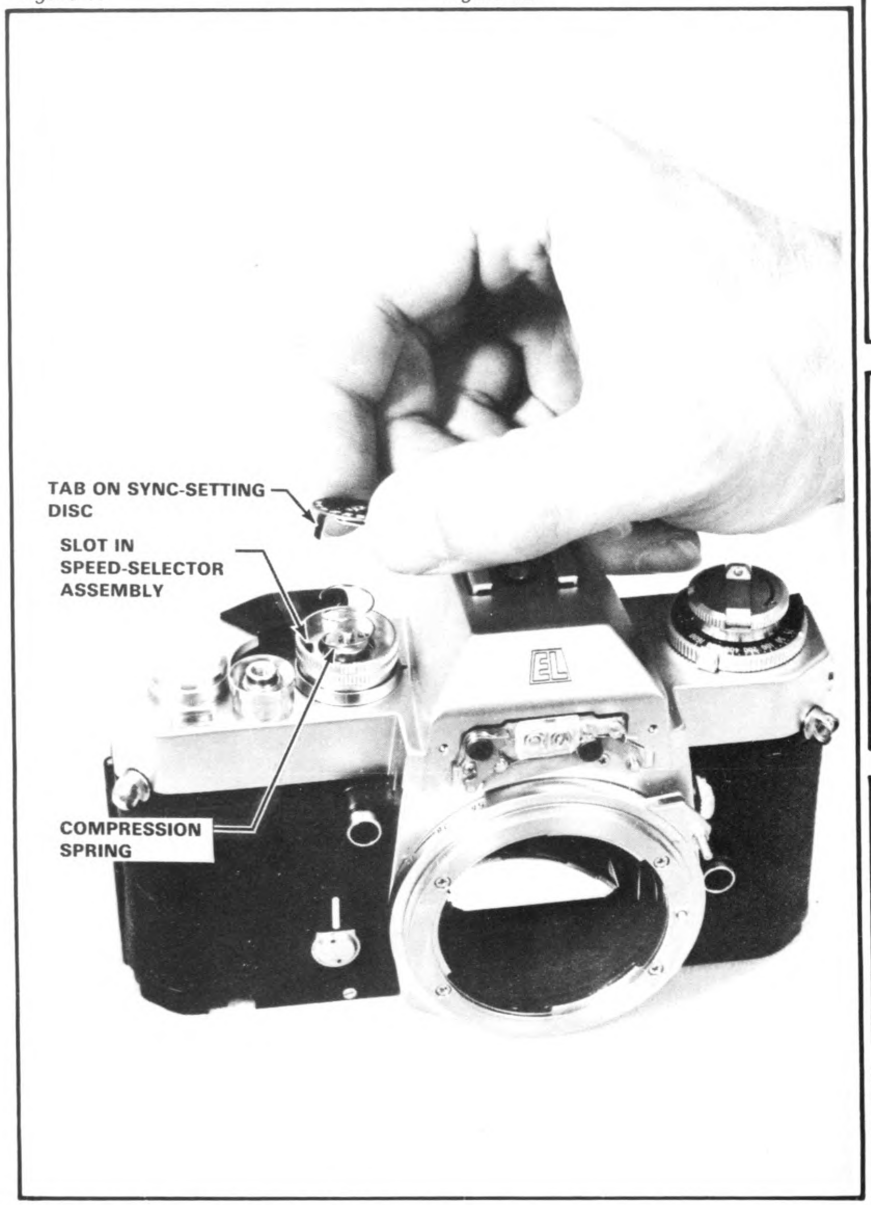


Figure 19

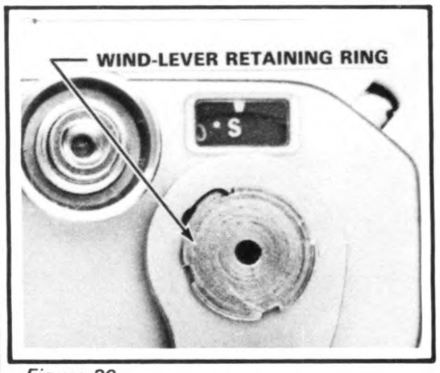


Figure 20

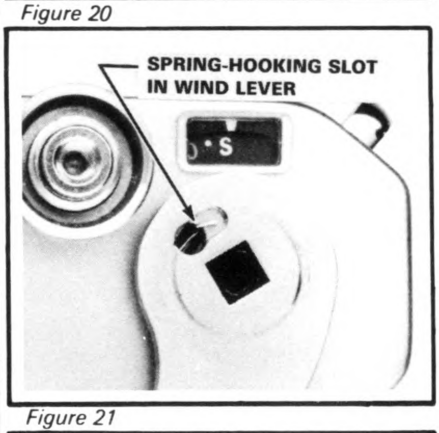


Figure 21

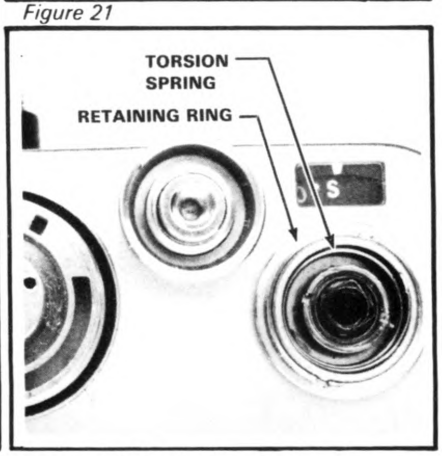


Figure 22

disturbed by shock. So, if the owner jars or drops the camera, the adjustments may need some touch-up. Later, we'll go through the adjustment sequence. But your repair may consist only of removing the nameplate and adjusting the two variable resistors shown in Fig. 16.

Next, remove the two top-cover screws -- one at the end of the top cover and one at the back of the top cover. Set the speed knob to the automatic setting and remove the two screws holding the speed-knob calibration plate.

Lift out the speed-knob calibration plate, the retainer plate, and the sync-setting disc. Also lift out the compression spring. You can now remove the speed knob, Fig. 17.

Notice the slot through the speed-selector assembly, Fig. 18. Looking through the slot, you can see the sync-selector switch. A tab on the sync-setting disc passes through a slot in the round sync-selector switch.

To replace the speed-knob components, first reach through the speed-selector slot, Fig. 18, with your tweezers. Turn the sync-selector switch clockwise until you can see the slot for sync-setting disc. The slot should be positioned at the end of the speed-selector slot as shown in Fig. 18.

Then, replace the speed knob -- align the speed-knob slot with the slot in the sync-selector disc, Fig. 17. The small pin on the underside of the speed knob should then drop into one of the two speed-selector holes, Fig. 18. The speed knob is now at the X-sync setting.

Seat the compression spring on top of the speed knob. You can then install the speed-knob calibration plate, the retainer disc, and the sync-setting disc as one assembly. Assemble the three discs as shown in Fig. 19. Then, as you seat the three discs, pass the tab on the sync-setting disc through the slot in the speed-selector assembly and into the slot in the sync-selector switch.

The biggest problem in removing the top cover comes after you've taken off the speed knob. You must now unscrew the retaining ring around the speed selector, Fig. 18. The retaining ring can be tough to remove. It has no spanner notches and it's a little hard to reach.

If you're repairing a lot of EL's, you may wish to make a special tool for the retaining ring. For example, you might cement an O-ring to a tubular handle. You need the tubular handle to clear the speed selector.

However, you can normally unscrew the retaining ring using a chunk of rubber. You'll also need that chunk of rubber to unscrew the wind-lever cap screw, Fig. 18. Unscrew the wind-lever cap screw and the retaining ring over the wind lever, Fig. 20. You can now see the end of the torsion-type spring hooked to a wind-lever slot, Fig. 21.

Disconnect the end of the torsion spring. Then, lift off the wind lever; the torsion spring stays in the camera, Fig. 22. On reassembly, first hook the wind-lever slot to the end of the torsion spring. Then, turn the wind lever counterclockwise until you can seat it over the squared wind shaft, Fig. 22.

Proceeding with the disassembly, unscrew the retaining ring around the wind shaft, Fig. 22. Then, wedge the rewind shaft and unscrew the rewind knob. Watch for the loose flat spring and washer on the rewind shaft, Fig. 23. The flat spring provides the tension for the rapid rewind crank.

Remove the two screws holding the film-speed calibration plate, Fig. 23. Lift off the film-speed calibration plate and the black insert that slips over the rewind-knob latch, Fig. 24.

Now take out the three screws holding the film-speed dial, Fig. 24. As you lift off the film-speed dial, the film-speed lock may stay in place. But normally the film-speed lock and the lock spring, Fig. 24, come out of the slot in the film-speed dial.

For reassembly reference, notice the slot in the lock spring; the film-speed lock passes through this slot, Fig. 25. Also notice that one edge of the slot is smaller in width -- this edge goes down, toward the camera.

Reseat the lock spring within the cutout of the film-speed dial. Then, pass the film-speed lock through the slot in the lock spring; a cutout on the underside of the film-speed dial provides clearance for the film-speed lock.

You're now ready to seat the film-speed dial. In Fig. 26, you can see the functional-resistor housing; this is the housing that contains the resistance element. The three screw holes in the housing receive the three screws which hold the film-speed dial. A slot in the housing receives the film-speed lock.

Turn the functional-resistor housing all the way counterclockwise -- that's the ASA 25 position. However, with the film-speed dial removed, the functional-resistor housing may turn slightly beyond ASA 25. Normally, the limiting plate under the functional-resistor housing, Fig. 26, limits how far the functional

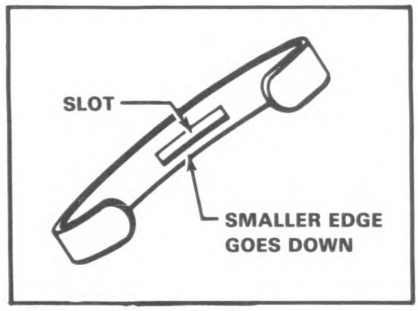


Figure 25 Lock Spring

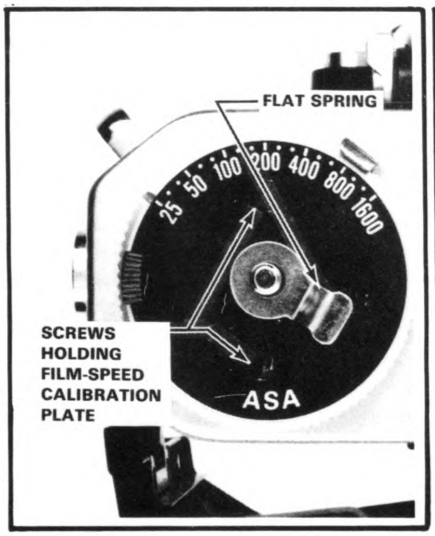


Figure 23

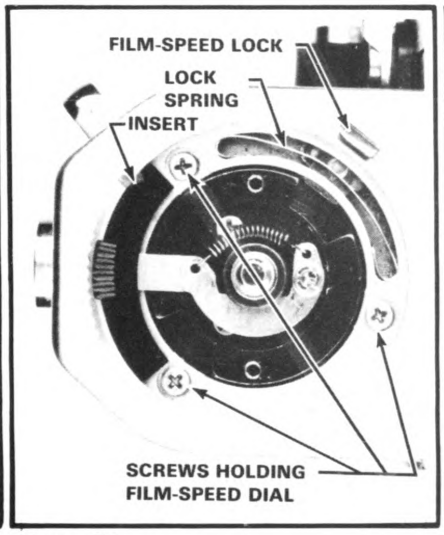


Figure 24

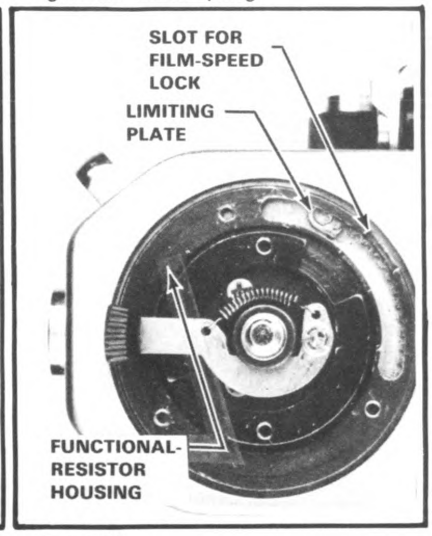


Figure 26

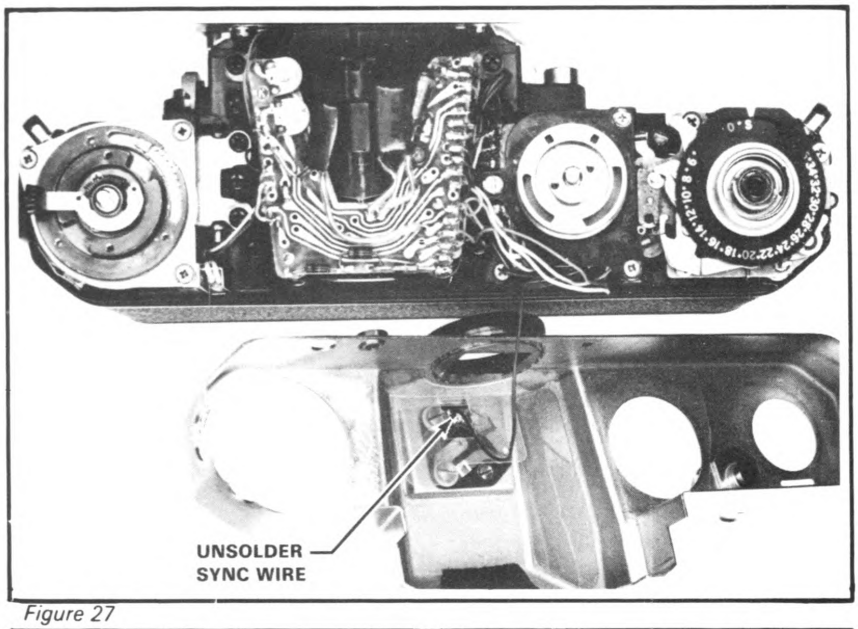


Figure 27

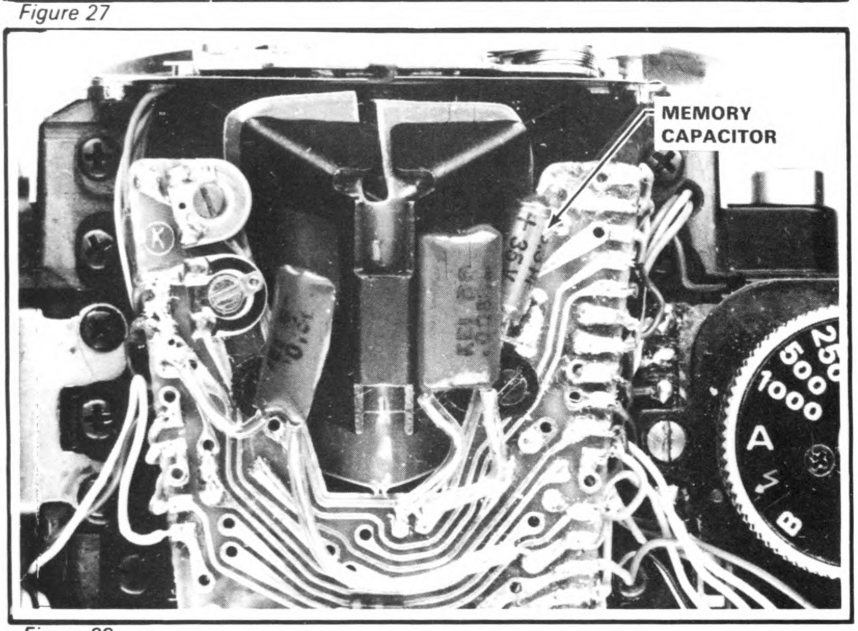


Figure 28

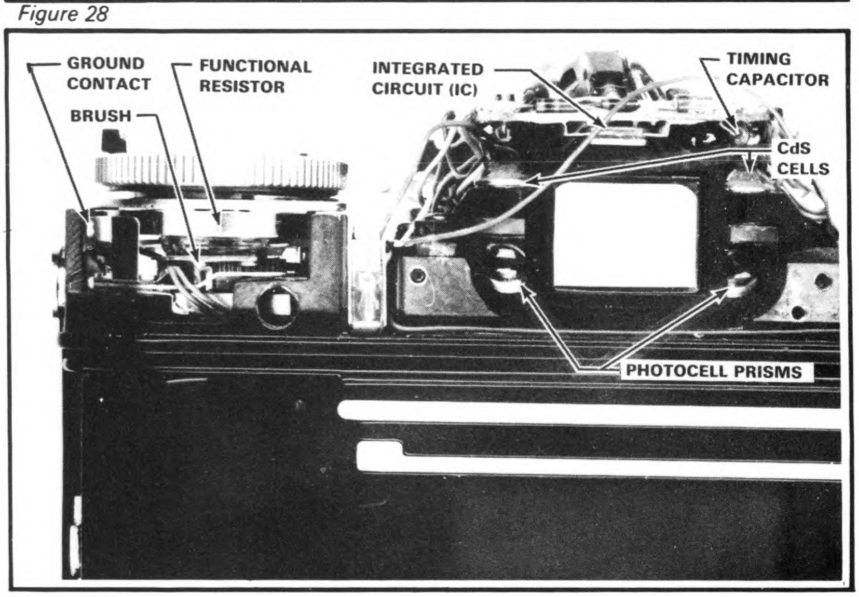


Figure 29

resistor may turn in each direction. The teeth in the limiting plate receive the pin on the underside of the film-speed lock.

As you seat the film-speed dial, slightly depress the film-speed lock. The pin on the underside of the film-speed lock should then drop into the first notch of the limiting plate; if it doesn't, you may have to turn the functional-resistor housing a slight distance in a clockwise direction.

Align the three screw holes in the film-speed dial with the three screw holes in the functional-resistor housing. You can then replace the three screws.

The film-speed dial is one of the parts you'll want to replace after removing the top cover. You'll then be able to check the operation and make the adjustments. To complete the removal of the top cover, unscrew the retaining ring around the battery-test button. Careful -- the battery-test button is now loose.

Lift out the loose battery-test button. Then, carefully lift aside the top cover. There's one wire hanging on -- the blue sync wire that runs to the hot-shoe contact, Fig. 27. Unsolder the blue wire from the hot-shoe contact.

Besides replacing the film-speed dial, you'll now want to replace the wind lever and the speed knob. You won't have to replace the film-speed calibration plate.

TROUBLESHOOTING MODULES

From the top of the camera, you can now check three of the assemblies that could be causing an electronic problem --the main circuit board on top of the pentaprism, Fig. 28, the functional resistor, and the speed selector.

All three of these assemblies come as complete modules. As you might expect, the cost of replacement modules runs quite high. So, before replacing any of the three modules, you want to make sure you've pinpointed the problem to the malfunctioning assembly.

In some cases, however, you can save on parts costs by replacing individual components. Most of the components on the main circuit board, for example, may be obtained individually. Those components include the memory capacitor, Fig. 28, the timing capacitor, Fig. 29, and the switching IC. You can just see the integrated circuit at the bottom of the main circuit board, Fig. 29.

Even the CdS cells connect to the main circuit board, Fig. 29. Prisms at the back of the camera, one on either side of the eyelens, allow the photocells to take a center-weighted reading from the focusing screen. How about the galvanometer? It's part of the speed-selector assembly.

The speed-selector assembly also con-

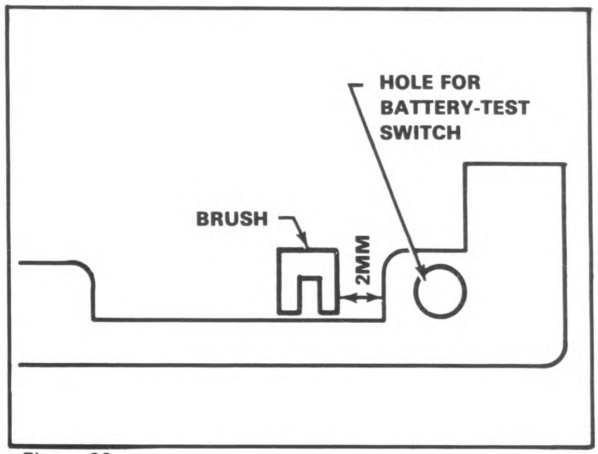


Figure 30

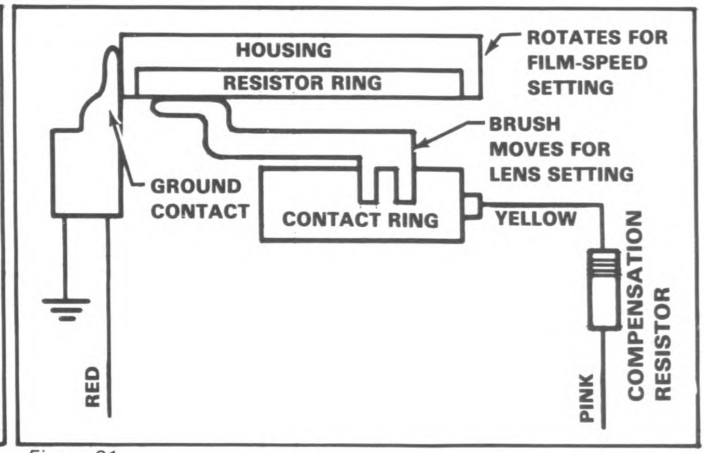


Figure 31

tains the shutter-speed resistors for manual settings, the switching circuit for selecting the automatic setting, and the flash-sync switch. But you'll probably find that most of your repairs on the three modules involve the functional resistor. So we'll start with the functional resistor in going through the troubleshooting steps.

CHECKING THE FUNCTIONAL RESISTOR

Earlier, we mentioned the tell-tale symptoms of a defective functional resistor (called "FRE" by Nikon). The needle shoots to the top of the focusing screen when you move the wind lever to the ready position. And the shutter delivers only the mechanical shutter speed when set to automatic. These symptoms normally indicate an open or poor contact in the functional resistor.

Looking at the back of the camera, locate the brush of the functional resistor, Fig. 29. The brush rides against a contact ring, and the contact ring connects electrically to the main circuit board.

Try turning the metering ring, Fig. 28, as you watch the brush. The brush should move with the metering ring. That's how the diaphragm setting programs the functional resistor; a gearing system connects the brush to the metering ring.

Fig. 29 shows the position of the brush when the metering ring is in the lens-removal position (turned fully clockwise as seen from the front of the camera). Notice that one wiper on the brush sits approximately 2mm from the edge of the body casting, Fig. 30. The actual position may vary slightly from camera to camera. But, before you remove the functional resistor for any purpose, you want to note the timed position.

You can't as yet see the actual resistance element. However, the drawing, Fig. 31, shows how the functional resistor works. The end of the brush shown against the contact ring is the end you see in Fig. 29. The other end of the brush rides against the resistance element, a metal-foil resistor ring.

A ground wiper rides against the housing of the resistor ring, Fig. 31 and Fig. 29. And a red wire connects the ground wiper to the ground terminal of the main circuit board. So, as the brush moves, the resistance between the red wire and the contact ring changes.

As we mentioned, changing the diaphragm setting moves the brush. How about the film-speed setting? Setting the film speed moves the entire resistor ring. Either way, you're changing the resistance between the red ground wire and the contact ring.

In our drawing, Fig. 31, a yellow wire connects the contact ring to a compensation resistor. The resistor mounts to the compensation circuit board in front of the functional resistor. However, you'll find quite a few variations here -- some cameras may use more than one compensation resistor, others may use none.

The compensation resistor provides an adjustment for balancing the linearity of the functional resistor. We'll describe its purpose in the section covering adjustments. However, you normally won't have to worry about changing the compensation resistor; consider it to be a factory adjustment, not a field adjustment.

A pink wire connects the compensation resistor to the main circuit board, Fig. 32. So, to check the functional resistor, you can measure the resistance between the pink wire and the red wire, Fig. 31.

In Fig. 33, we've disconnected the pink wire from the main circuit board. And we've connected an ohmmeter between the pink wire and ground (any metal portion of the camera). Changing the film-speed setting or the position of the metering ring should change the resistance reading.

Using this technique, your actual measurements may differ from those in

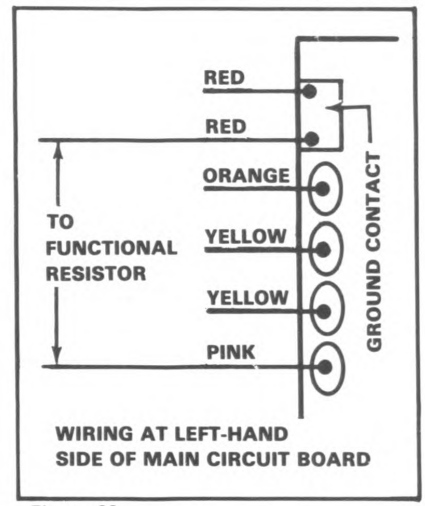


Figure 32

our evaluation camera. But the resistance should smoothly decrease as you set smaller lens apertures (or turn the metering ring counterclockwise). And the resistance should smoothly decrease as you set slower film speeds.

Turn the film-speed dial all the way counterclockwise (as seen from the top) -- that's the ASA 25 position. At ASA 25, we measured 45K in our evaluation camera when the metering ring was in the lens-removal position, Fig. 33.

This resistance should increase to around 110K at ASA 100 and around 660K at ASA 1600. However, since we've hooked the ohmmeter across the compensation resistor and ground, the actual value will vary in different cameras (depending on the value of the compensation resistor).

If you read an open at any point in the operation, you may have a bad resistor ring. Some technicians then replace the complete functional-resistor assembly. But you can save on parts costs by just replacing the resistor ring. Although replacing the resistor ring takes a little more work, the savings may be worth the effort.

Also, the functional resistor may simply have poor brush contact. Reforming the



Figure 33

brushes and cleaning the contact surfaces may cure an apparent open. Or you may encounter a mechanical-coupling problem. Here, the camera we used for the illustrations provides a good example.

Our sample camera showed the symptoms of a bad functional resistor. The needle stayed at the top of the focusing screen, and the shutter delivered the mechanical speed on automatic. Yet, when checking the brush, we found there was no movement as we turned the metering ring.

The problem turned out to be a loose setscrew on the coupling pinion (part of the gearing system between the metering ring and the brush). Simply tightening the setscrew solved the problem.

For any of the malfunctions we've described, you must remove and retime the functional-resistor assembly. Removing the functional resistor also affects the exposure adjustments. So, anytime you remove the functional resistor, you can plan on going through the adjustment sequence.

REMOVING THE FUNCTIONAL RESISTOR

Whenever you remove or replace the functional resistor, make sure the metering ring is in the lens-removal position, Fig. 33. Remember, the brush of the functional resistor should then be positioned as shown in Fig. 30

It isn't necessary to remove the film-speed dial as we've done in Fig. 34. Just pull up the rewind shaft to open the camera back. Then, disengage the rewind-shaft latch and drop out the rewind shaft toward the bottom of the camera.

Now, remove the three screws holding the functional-resistor assembly, Fig. 34. Be careful as you lift out the functional resistor -- an internal spring turns the brush clockwise (as seen from the bottom, Fig. 35). Since a stop limits how far the brush assembly can rotate, you won't lose the initial tension.

In Fig. 35, notice how the two wipers of the brush curl over the end of the functional-resistor assembly. You may have to reform the brush slightly to assure good contact with the contact ring, Fig. 36.

You can now see the other end of the brush -- the end that rides against the resistor ring -- in Fig. 35. The resistor ring itself should appear bright and shiny. To check the functional resistor with the assembly removed, connect one ohmmeter lead to either brush; connect the other ohmmeter lead to ground (such as to the metal support plate).

With the brush assembly turned fully clockwise, Fig. 35, you should read a large resistance -- around 11 megohms. The resistance should smoothly decrease as you turn the brush assembly counterclockwise. You should get a low reading of around 1.9K just before the brush reaches the end of the resistor ring.

What if the resistor ring is defective? You can then replace the functional-resistor assembly. Or, as we mentioned earlier, you may prefer to disassemble the functional-resistor assembly and replace the resistor ring. The actual metal-foil resistor ring (part #626) doesn't come separately. But you should be able to get the subassembly H5-1 which includes the resistor ring and its housing.

In Fig. 36, you can also see part of the linkage system. The metering gear engages the gear on the brush assembly, Fig. 35. A gearing system connects the metering gear with the metering ring.

Try turning the metering ring counterclockwise (as seen from the front of the camera). The metering gear, Fig. 36, should then turn counterclockwise. Now, slowly turn the metering ring clockwise; you should hear the clicking sound as the internal ratchet system programs the maximum-lens aperture.

Stop turning the metering ring when the ratchet engages. Now the metering gear should turn with the metering ring in both directions -- counterclockwise as the metering ring moves in the smaller-aperture direction and clockwise as the metering ring moves in the larger-aperture direction.

Looking under the metering gear, you can see the pinions that provide the

coupling. If the metering gear isn't turning with the metering ring, check for a loose setscrew on one of the pinions.

REPLACING THE FUNCTIONAL RESISTOR

Before replacing the functional resistor, return the metering ring to the lens-removal position. Then, turn the brush assembly around 1/4 turn in a counter-clockwise direction -- until the contacting brush is in the position shown in Fig. 29. Hold the brush assembly in place, against the spring tension.

Tilt the functional resistor slightly toward the front of the camera as you seat the assembly. That way, you can make sure the contact-ring brush comes against the outer edge of the contact ring. Be very careful when seating the functional resistor -- if the brush comes against the top of the contact ring, there'll be some damage. You'll then have to reform the brush.

Once you've seated the functional resistor, check the brush position, Fig. 29. The brush should be in the position you noted prior to disassembly. If it isn't, you'll have to lift out the functional resistor and try again.

EXPOSURE ADJUSTMENTS

Disturbing the timed position of the functional resistor affects the exposure adjustments. So you'll want to check the adjustments after replacing the functional resistor. Also, as mentioned earlier, many of your EL repairs simply involve setting up the adjustments.

Some technicians prefer to use a dummy top cover for making the exposure adjustments. By making special clearance cutouts in your top cover, you can reach the variable resistors on the top circuit board, Fig. 37.

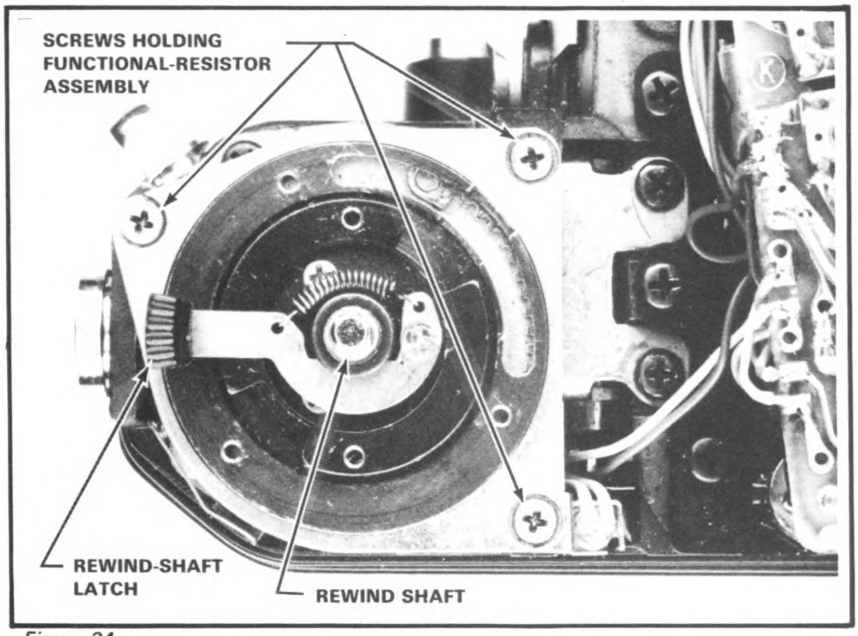


Figure 34

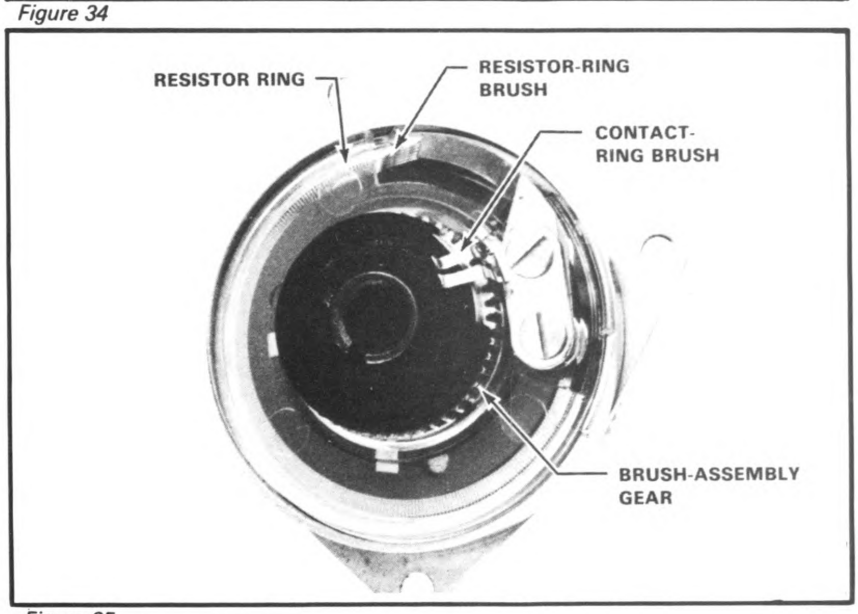


Figure 35

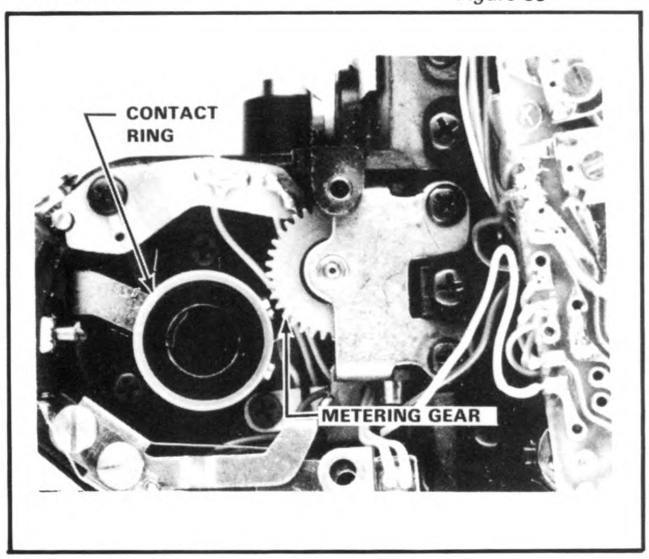


Figure 36

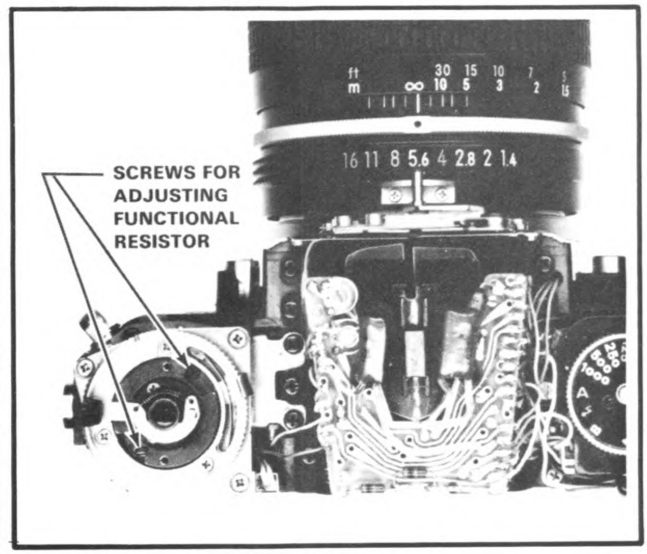


Figure 37 Settings For EV 9 Adjustment

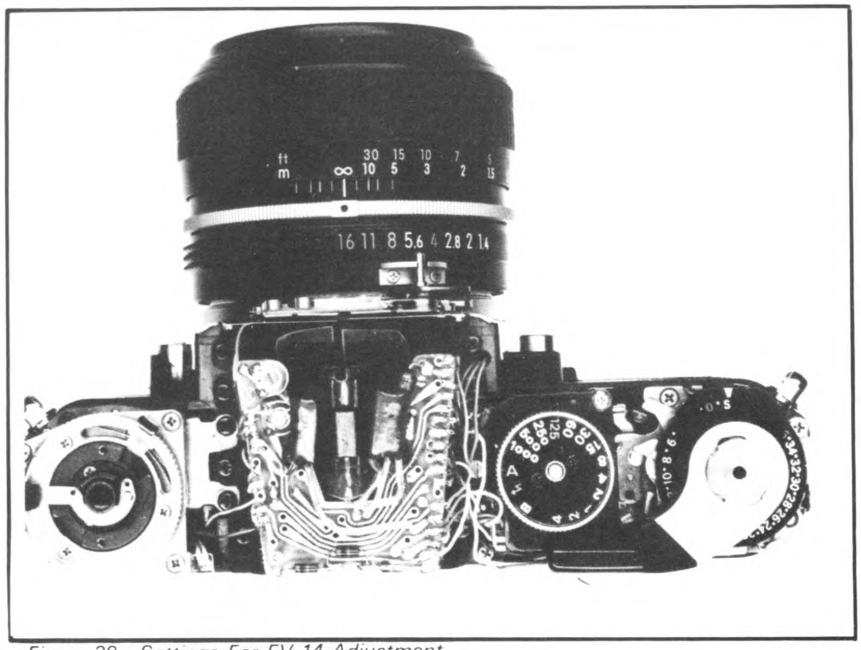


Figure 38 Settings For EV 14 Adjustment

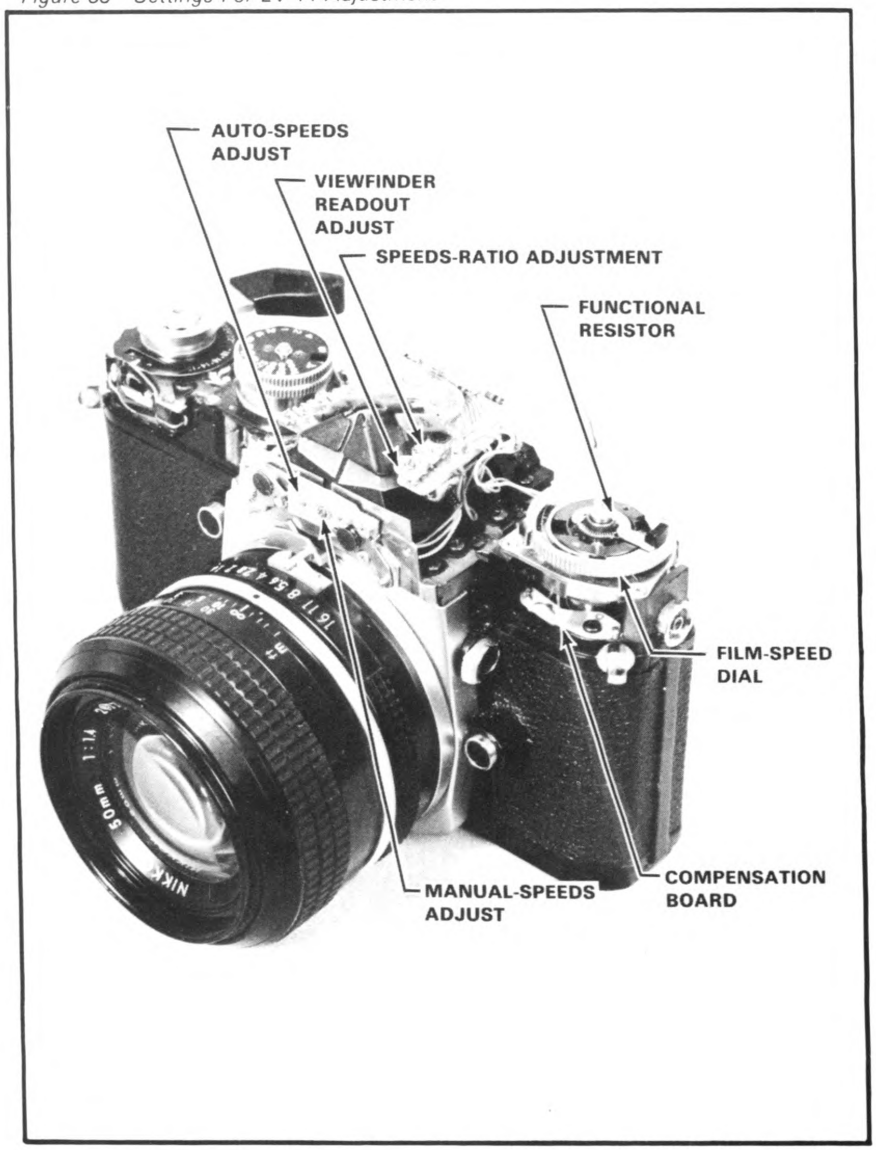


Figure 39

However, you can do the job by just using your hand to block off ambient light. Cover the top of the pentaprism while testing the exposure. Also, be sure to cover the two photocell prisms next to the eyelens.

To set up the exposure system from scratch, you must first adjust the functional resistor. Locate the two screws in the film-speed assembly, Fig. 37; you'll probably have to change the film-speed setting to uncover the screws. After loosening the two screws, you can turn the inner section of the functional resistor (the section containing the resistor ring).

The functional-resistor adjustment provides your main control over the meter reading and the automatically controlled exposures. That's why adjusting the functional resistor should be your first step in the adjustment sequence.

Before making any adjustments, however, you might check the needle position with the meter turned off (with the wind lever in the storage position). Remember, the needle should center in the black square next to the 1/15-second calibration. What if it doesn't? In that case, you'll have to remove the speed-selector assembly and adjust the zero position. We'll describe this procedure a little later; unless someone has already removed the speed-selector assembly, there's little reason for the needle position to be incorrect.

Setting up the exposure adjustments requires at least two light levels:

1. *EV 9 (the f/2 light level on the Comparalumen or AutoLumen-CV)*
2. *EV 14 (the f/11 light level on the Comparalumen or AutoLumen-CV).*

The Nikon service manual also indicates a third light level -- EV 4. But we've found the two light levels to be satisfactory.

You must also set two film-speed settings -- one for each light level. However, you don't have to replace the film-speed calibration plate. You'll make one test at ASA 25; set ASA 25 by turning the film-speed dial all the way counterclockwise, Fig. 38. You'll make your other test at ASA 100. To set ASA 100, start at the ASA 25 position of the film-speed dial. Then, turn the film-speed dial six clicks in a clockwise direction, Fig. 37.

Now, set your light source to the EV9 light level. Set the diaphragm to f/5.6, Fig. 37. And set the film speed to ASA 100. Hold the camera's lens against the light source window. While covering the pentaprism and the photocells prisms, look through the finder. The needle should indicate 1/15 second.

If the needle is above or below the 1/15-second calibration, make your adjustment on the functional resistor. Loosen the two screws shown in Fig. 37. Then, move the screws within the elongated slots to reposition the resistance element.

Turning the resistance element clockwise moves the needle further up -- a faster shutter-speed reading. Turning the resistance element counterclockwise moves the needle further down -- a slower shutter-speed reading.

Turn the center section of the functional resistor in the proper direction and retighten the screws. Then, again set ASA 100 to check your adjustment.

Next, set your light source to EV 14. Change the film-speed setting to ASA 25. And set the diaphragm-setting ring to f/16. Once again check the position of the needle -- it should still indicate 1/15 second.

If the needle reads properly at EV9 --yet reads high or low at EV14 -- you may have to compromise. Set the functional resistor to place the needle as close as possible to 1/15 second at both light levels. There's an adjustment for balancing the reading at both light levels -- change the resistor on the compensation board, Fig. 39. However, that's the adjustment you normally don't want to disturb; it takes too much time to juggle fixed resistors.

We mentioned that adjusting the functional resistor provides your main control over the viewfinder readout. But you also have a variable-resistor adjustment, Fig. 39. Set the speed knob to the automatic setting, set the film speed to ASA 100, and set the diaphragm to f/2.

Again, be sure you shield the photocells from ambient light as you take a reading. The needle should indicate 1/500 second. If the reading is off, make your adjustment on the viewfinder-readout variable resistor, Fig. 39. Turning the wiper of the variable resistor in a counterclockwise direction moves up the needle.

The next step is to adjust the automatically controlled shutter speeds. Nikon suggests using the EV 9 light level. Set the speed knob to the automatic position, set the film speed to ASA 100, and set the diaphragm opening to f/5.6.

Cover the pentaprism and eyelens as you take an exposure reading. The shutter should deliver a shutter speed of 1/15 second. Make your adjustment with the auto-speeds variable resistor, Fig. 39. Turning the wiper clockwise gives you a slower shutter speed.

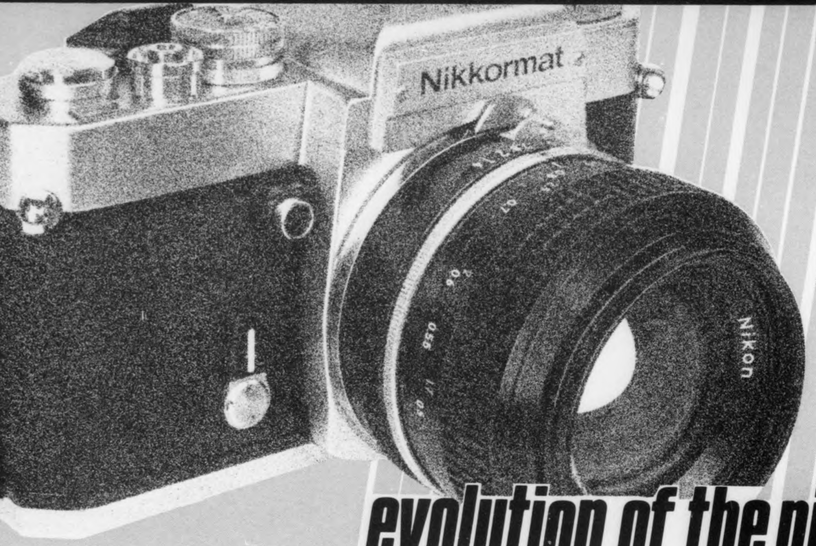
Finally, use the manual-speeds variable resistor to adjust the manually set shutter speeds. Here, any type of shutter-speed test instrument does the job. You might try adjusting the manual-speeds variable resistor to bring in a fast shutter speed (1/500 second or 1/1000 second). Then check the slower shutter speeds.

You may find that bringing in the high speeds makes the other manually set speeds too fast -- a linearity problem. In that case, use the manual-speeds variable resistor to adjust the 1/125-second setting (remember, you should be getting 1/100 second at this setting). And use the capacitor-shorting switch adjustment to adjust the fast speeds.

The adjustment on the capacitor-shorting switch has a significant effect on 1/500 second and 1/1000 second. Yet it has very little effect on the slower speeds. Although the capacitor-shorting switch is inside the shutter assembly, Nikon provides an easy-access route. Just peel back the leatherette above the delayed-action cocking lever until you can see a cemented cover disc. Remove the cover disc. You can now reach the eccentric adjustment through a special front-plate clearance hole.

What about the other variable-resistor adjustment on the main circuit board? The speeds-ratio adjustment, Fig. 39, affects both the manually set shutter speeds and the automatically controlled shutter speeds. But most technicians consider the speeds-ratio variable resistor to be a factory-adjustment point -- not a field-adjustment point. You should not have to disturb the speeds-ratio variable resistor.

continued next issue



evolution of the nikkormat el

Part II by Larry Lyells

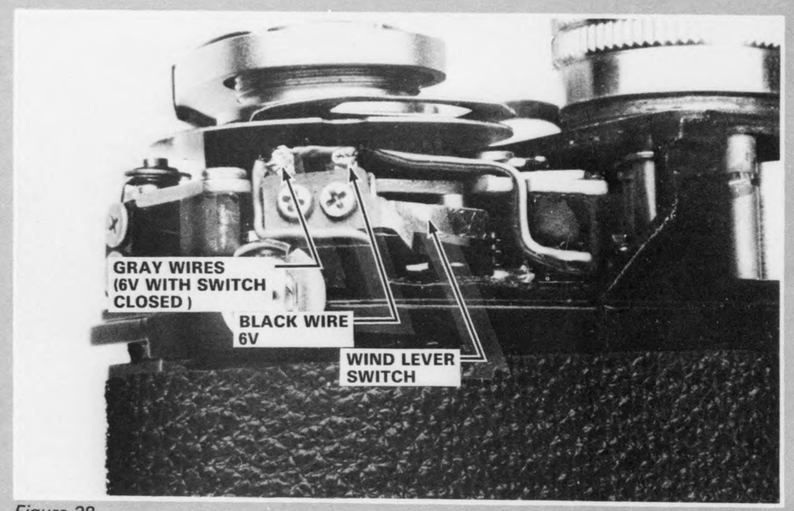


Figure 38

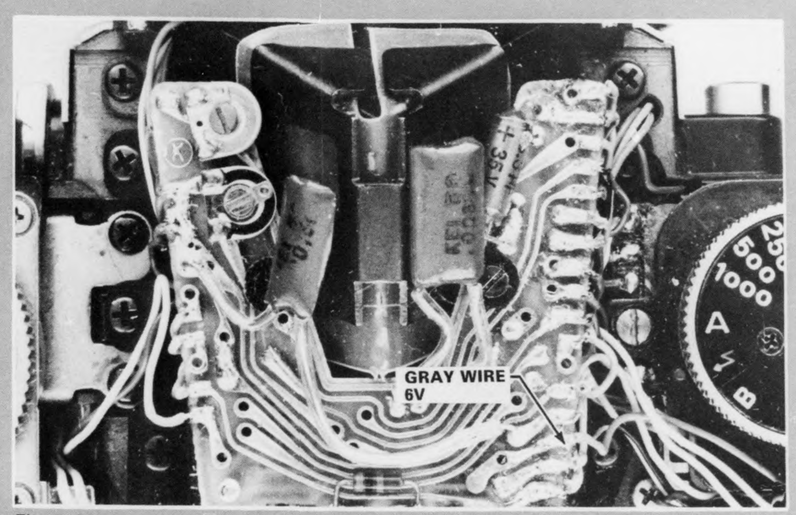


Figure 39

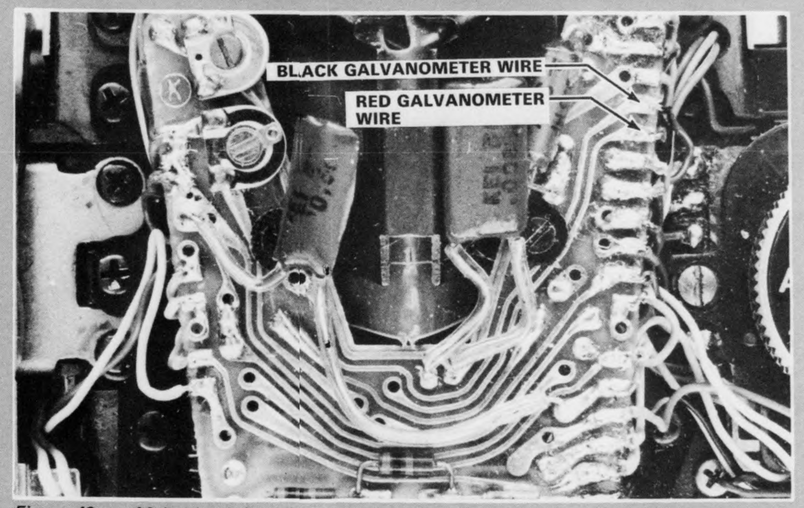


Figure 40 Main circuit board

CHECKING THE WIND-LEVER SWITCH

Earlier, we mentioned that the wind-lever switch serves as the master switch for the entire camera. The wind-lever switch must be closed before anything works electronically.

You can see the wind-lever switch at the front of the camera, Fig. 38. The wind-lever switch should close when you move the wind lever to the ready position. Moving the wind lever to the storage position should open the wind-lever switch

To check the wind-lever switch, measure the voltage between ground (positive) and the black-wire contact, Fig. 38. You should measure the full battery voltage; a reading of over 6 volts tells you that battery power is reaching the wind-lever switch.

Then, check the voltage between ground and the gray-wire contact, Fig. 38. With the wind-lever switch open, you should read 0 volt. When you close the wind-lever switch, you should read the full battery voltage.

If the wind-lever switch passes these tests, you know there's no problem. But is the battery voltage reaching the main circuit board? With the wind-lever switch closed, you should measure the battery voltage at the gray-wire contact, Fig. 39.

TESTING THE SPEED-SELECTOR ASSEMBLY

Several possible malfunctions could result from a problem in the speed-selector assembly; that's because the speed-selector assembly performs quite a few of the camera's functions. Most of the parts for the speed-selector assembly aren't available individually. So, if there's a problem in the speed-selector assembly, you may have to replace the entire unit.

Here's a breakdown of the jobs performed by the speed-selector assembly:

- it provides the switching action that decides the shutter-speed mode -- automatic or manual
- it provides the shutter-speed resistors for the manually set shutter speeds
- it provides the sync-selector switch for the two flash-sync settings
- it contains the galvanometer for the shutter-speed readout.

A failure in any of these areas, then, could indicate a problem in the speed-selector assembly. Before replacing the speed-selector assembly, however, you want to make sure you've isolated the problem. Let's now go through the individual troubleshooting steps for the speed-selector assembly.

CHECKING THE GALVANOMETER

If there's a problem with the galvanometer, you won't get the shutter-speed readout -- the needle will remain at the 1/15-second position. Yet everything else works properly.

But you could get the same malfunction if the galvanometer isn't getting the proper current from the main circuit board. So, when you aren't getting a shutter-speed readout, the problem could be in the main circuit board or in the speed-selector assembly.

You can isolate the problem pretty quickly by making your first check on the galvanometer. Locate the red wire and the black wire connected to the wind-lever side of the main circuit board, Fig. 40 -- these are the galvanometer wires.

To check the continuity of the galvanometer coil, measure the

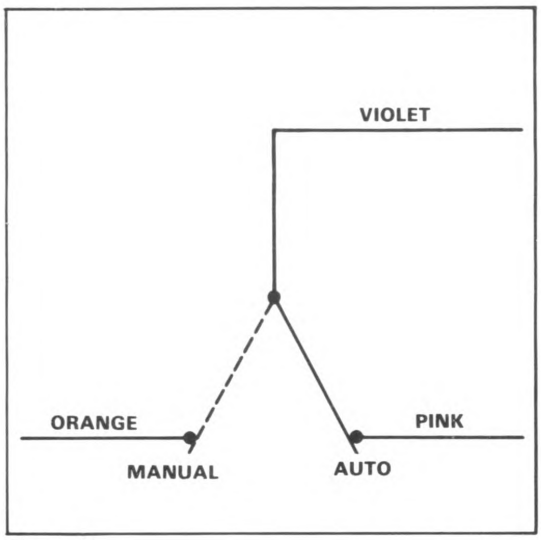


Figure 41

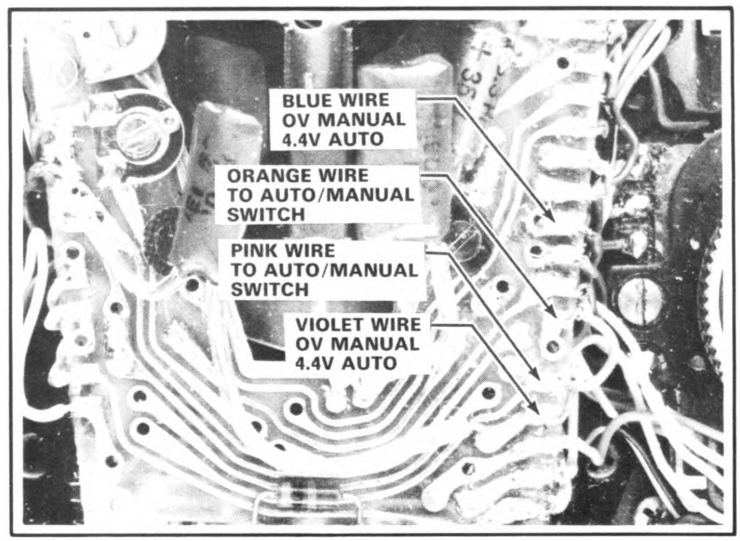


Figure 42 Main circuit board

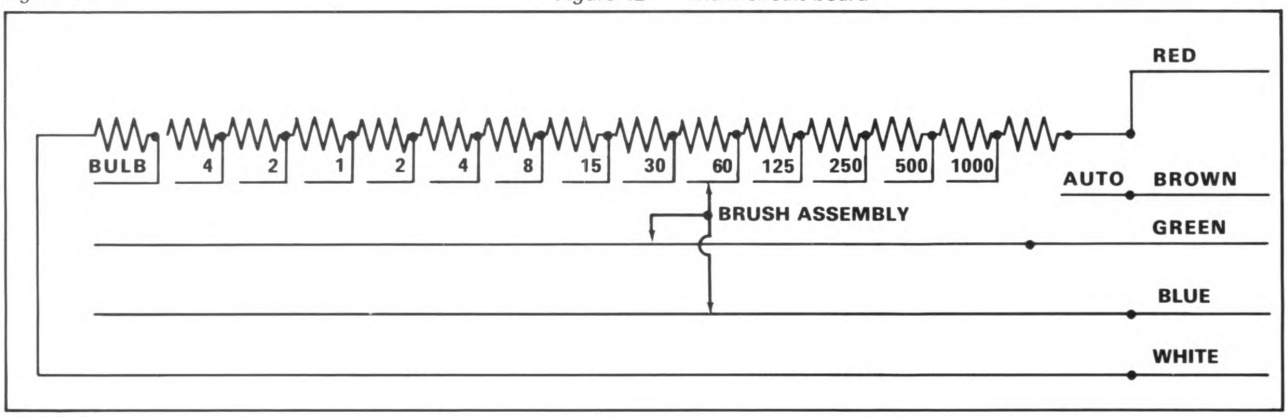


Figure 43

resistance between the two wires. You should read around 2.4K. If you read an open, you know that you have a defective galvanometer. And you must replace the complete speed-selector assembly.

CHECKING THE AUTO/MANUAL SWITCH

The auto/manual switch is a two-position switch at the bottom of the speed-selector assembly, Fig. 41. At the automatic setting, the switch moves to the solid-line position in Fig. 41. Turning the speed knob to one of the manually set shutter speeds shifts the switch to the dashed-line position.

You can check the auto/manual switch without removing the speed-selector assembly. Here, you can use either a voltmeter or an ohmmeter.

Using a voltmeter, try checking between ground (positive) and the violet-wire contact of the main circuit board, Fig. 42. You should measure 0 volt with the speed knob at a manual shutter-speed setting. At the automatic setting, you should measure around 4.4 volts (this was the voltage measurement from our evaluation camera, not a factory specification).

Make the same test between ground and the blue-wire contact, Fig. 42. Your voltage readings should be the same as in the previous test -- 0 volt at a manual shutter-speed setting and 4.4 volts at the automatic setting.

To check the auto/manual switch using an ohmmeter, measure the resistance between the orange wire and the violet wire, Fig. 42. You should get no continuity at the automatic setting; at a manual shutter-speed setting, you should get a direct short.

Next, test the continuity between the violet wire and the pink wire, Fig. 42. You should now get results just opposite from those in the first ohmmeter test -- no continuity at the manual setting and direct contact at the automatic setting.

CHECKING THE MANUAL SPEED—SETTING RESISTORS

What if you have a problem with the manual speed-setting resistors? You may then find that the camera works properly on the automatic setting. But the shutter hangs open on the manual settings.

Fig. 43 shows the schematic for the manual speed-setting resistors. As you change the shutter-speed setting to a slower speed, you're adding resistors in series. Increasing the series resistance increases the time it takes for the timing capacitor to charge. And the longer it takes for the timing capacitor to charge, the slower the resulting shutter speed.

There may be a break somewhere along the string of manual resistors. In that case, some of the manually set shutter speeds may work properly. But the shutter will hang open at any of the shutter speeds at the other side of the break.

For example, suppose there's an open between the 1/500-second resistor and the 1/250-second resistor, Fig. 43. The camera may then work fine on the two fastest speeds -- 1/500 second and 1/1000 second. But it will hang open at the speeds of 1/250 second and slower.

Here's another possibility -- the brush isn't making good contact with the circuit-board lands, Fig. 43. In that case, the shutter will probably hang open at all of the manually set shutter speeds.

Does the cause of the problem make any difference? It could. If there's an open along the string of resistors, you'll probably have to replace the complete speed-selector assembly. But if there's poor contact between the brush and the

circuit-board lands, you may be able to make a satisfactory repair. Cleaning the contact points does require that you disassemble the speed-selector assembly. Still, taking the time to disassemble the assembly may cost less than having to buy a new unit.

But you don't have to disassemble the speed-selector assembly to test the resistors. Notice in Fig. 43 that a red wire connects to one end of the resistor series. As you change the shutter speeds, the resistance should change between the red wire and the green wire, Fig. 43. You should get the same resistance change between the red wire and the blue wire in Fig. 43.

So, to check the manual speed-setting resistors, first disconnect the red wire from the main circuit board, Fig. 44. Now measure the resistance between the red wire and the green wire, also shown in Fig. 44, as you change the shutter speeds. The following table shows the resistance value at each shutter-speed setting as measured from our evaluation camera:

SHUTTER SPEED	RESISTANCE
1/1000	3.73K
1/500	5.41K
1/250	8.05K
1/125	13.1K
1/60	18.2K
1/30	27.4K
1/15	41.6K
1/8	64.5K
1/4	100K
1/2	152K
1	242K
2	379K
4	581K

Repeat the test by measuring the resistance between the red wire and the blue wire, Fig. 44. You should measure the same resistance at each setting as you did between the red wire and the green wire.

REMOVING THE SPEED SELECTOR

Removing the speed selector requires that you unsolder several wires from the main circuit board. You have to be especially careful when resoldering the wires. As you can see in Fig. 44, the circuit-board lands sit quite close to one another; it's easy to bridge adjacent lands by using too much solder.

You also must unsolder a couple of wires from the shutter circuit board, Fig. 45. The capacitor shown in Fig. 45 connects in parallel with the electromagnet (the electromagnet that holds open the shutter). To reach the shutter circuit board, you can move the capacitor out of your way as shown in Fig. 46. Or you can

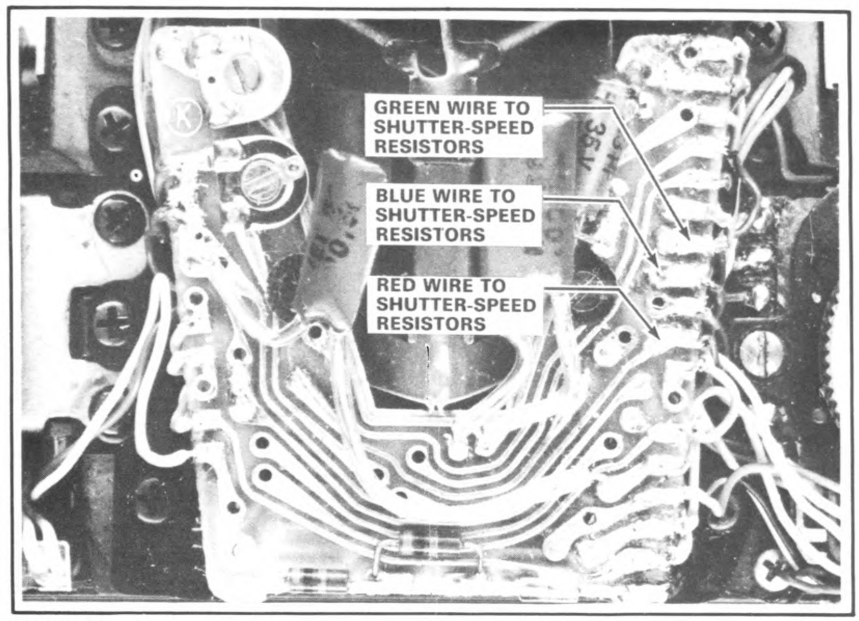


Figure 44

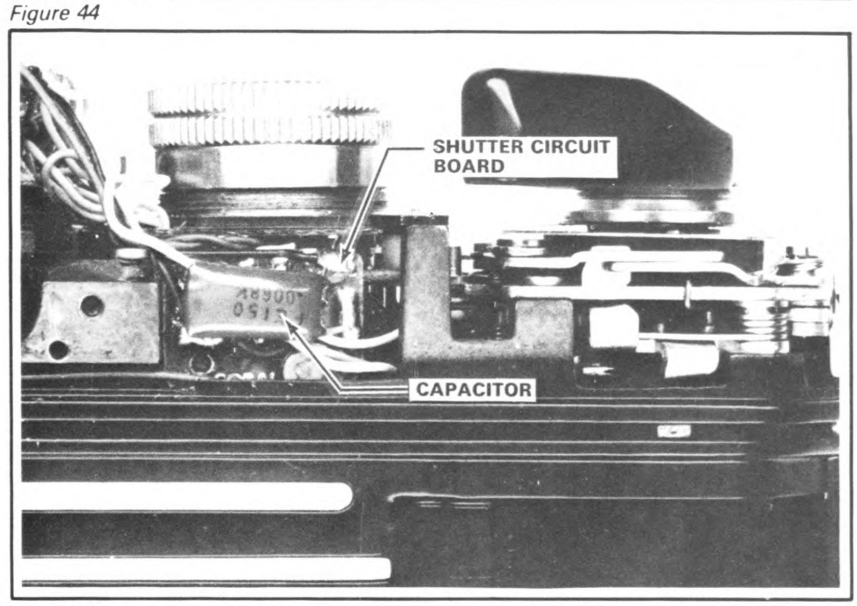


Figure 45

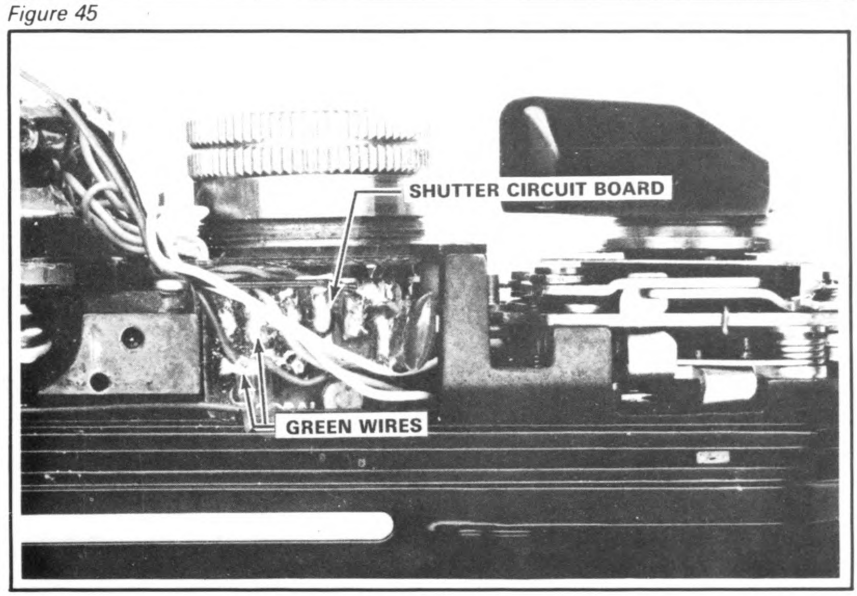


Figure 46

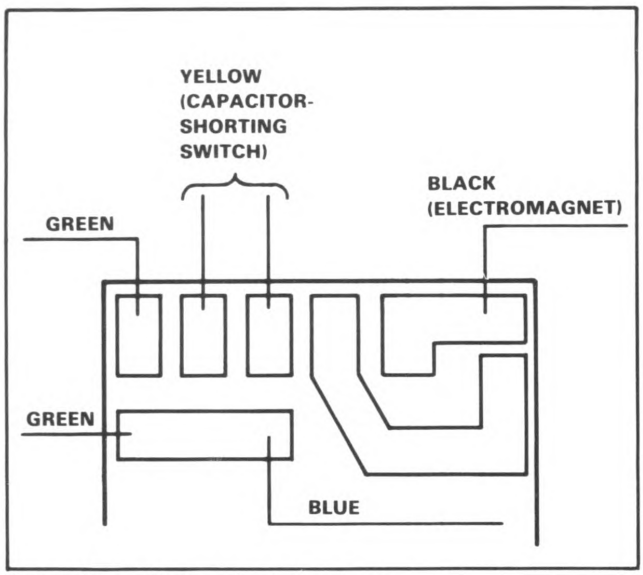


Figure 47 Shutter circuit board

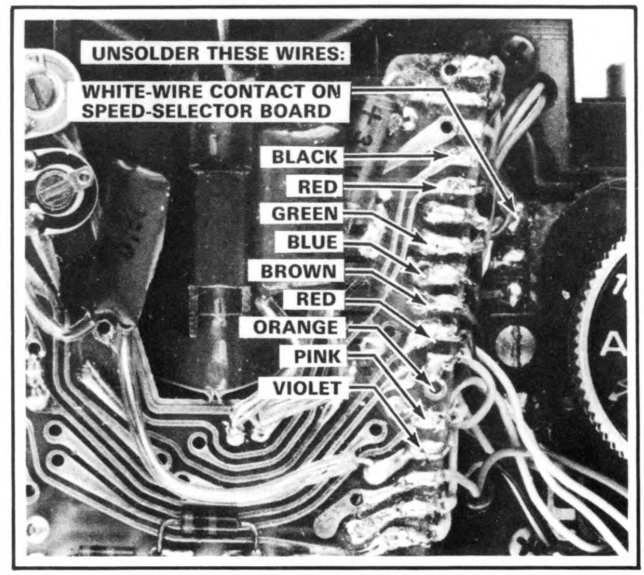


Figure 48 Removing focusing screen before taking out speed selector

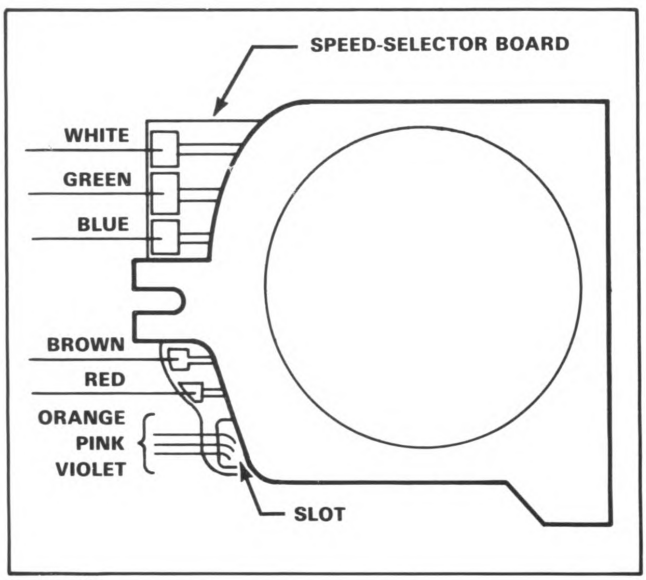


Figure 49

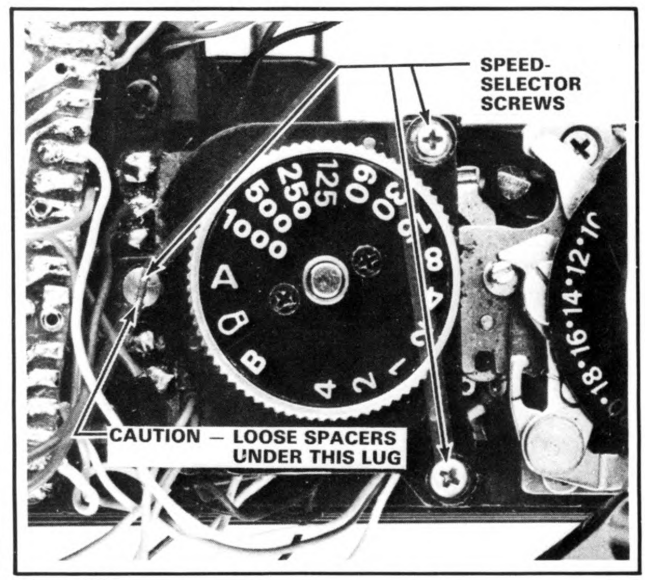


Figure 50

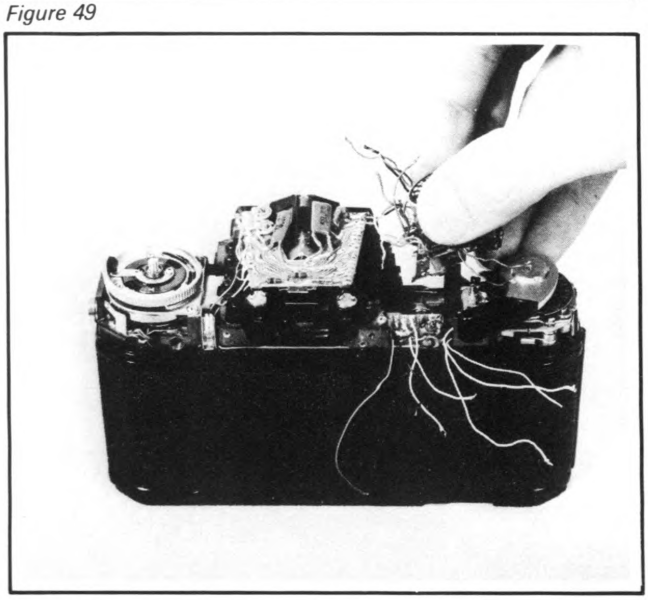


Figure 51

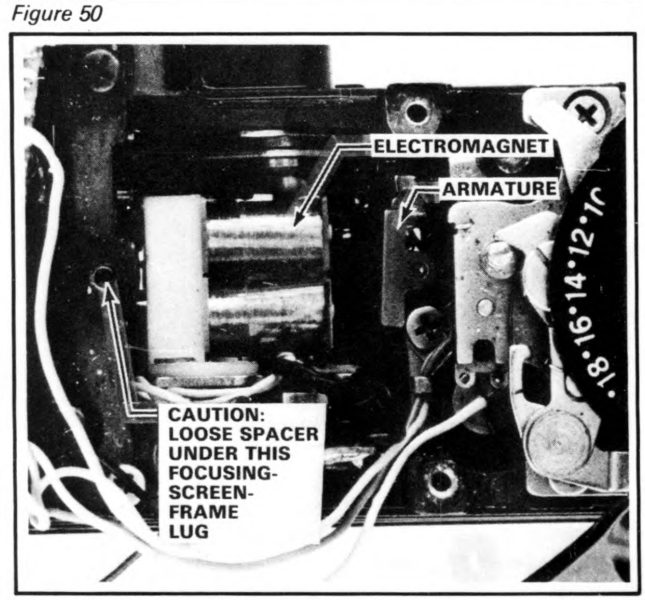


Figure 52 Shutter released

simply unsolder the capacitor from the board. Later models of the EL eliminated the capacitor.

Now, unsolder the two green sync wires from the shutter circuit board, Fig. 47; these wires remain with the speed selector. Also unsolder the white wire from the speed-selector board, Fig. 48; this wire comes from the bulb switch.

The other wires at the speed-selector board, Fig. 49, connect to the shutter-speed resistors. You can unsolder these wires either from the speed-selector board or from the main circuit board (it's a little easier to unsolder the wires from the main circuit board -- you aren't so cramped for space).

Fig. 48 indicates the wires to unsolder from the main circuit board. These are:

- the green wire, the red wire, and the blue wire coming from the shutter-speed resistors
- the red wire and the black wire coming from the galvanometer
- the brown wire coming from the auto land on the speed-selector board
- the orange wire, the violet wire, and the pink wire coming from the auto/manual switch in the speed selector.

Now, remove the three screws holding the speed-selector assembly, Fig. 50. Notice that one of the screws has a slotted (rather than cross-point) head; this screw passes through a U-shaped lug on the speed selector. Careful -- *there are two loose spacers under the U-shaped lug.*

With a little manipulation, you can now lift out the speed selector. Tilt the speed selector as shown in Fig. 51 for both removal and replacement. Be very careful -- especially on reassembly -- to avoid damaging the needle and the shutter-speed scale of the galvanometer. Lift out the two spacer washers after removing the speed selector.

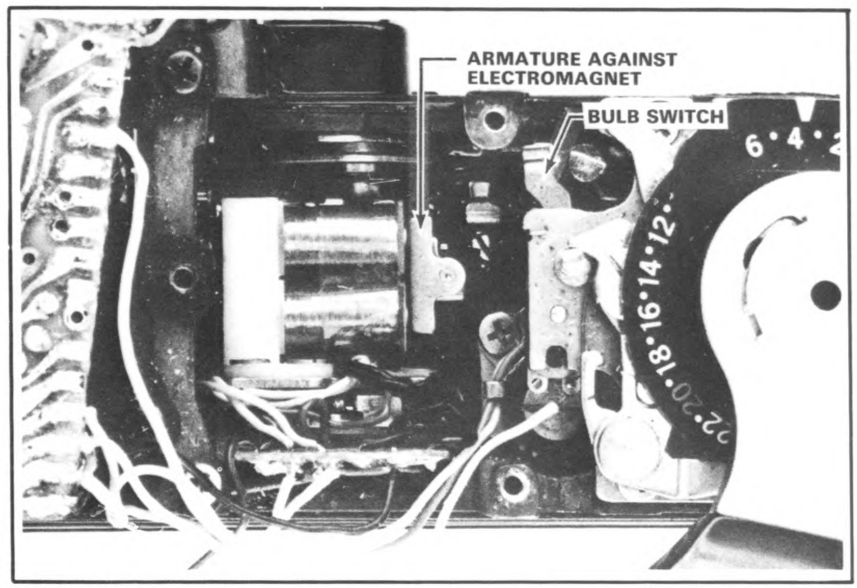


Figure 53

On reassembly, seat the speed selector by first feeding the shutter-speed scale through the mirror-cage cutout. Then, look through the finder to assure that you can see the needle and the scale. Before replacing the screws, slip the two spacer washers under the U-shaped cutout, Fig. 50.

Notice in Fig. 52 that you can now see the armature and the electromagnet. When you cock the shutter, the armature moves against the electromagnet's core, Fig. 53. Try holding the armature against the core as you release the shutter; the shutter should stay open for as long as you hold the armature.

DISASSEMBLY OF THE SPEED SELECTOR

You can see the auto/manual switch at the bottom of the speed selector, Fig. 54. The earlier models of the EL, like the one shown here, use a wire-type switch; later models changed to a sliding switch.

In Fig. 54, the auto/manual switch is at the automatic position. Turning the speed knob to a manually set shutter speed moves the center wire as shown in Fig. 55.

As mentioned earlier, the speed selector comes as a complete unit -- you can't obtain individual replacement parts. So why would you want to disassemble the unit? There's no point in taking apart the speed selector if you have a defective galvanometer, Fig. 55; you must then replace the complete speed selector.

However, if your previous tests pinpointed a problem to the shutter-speed

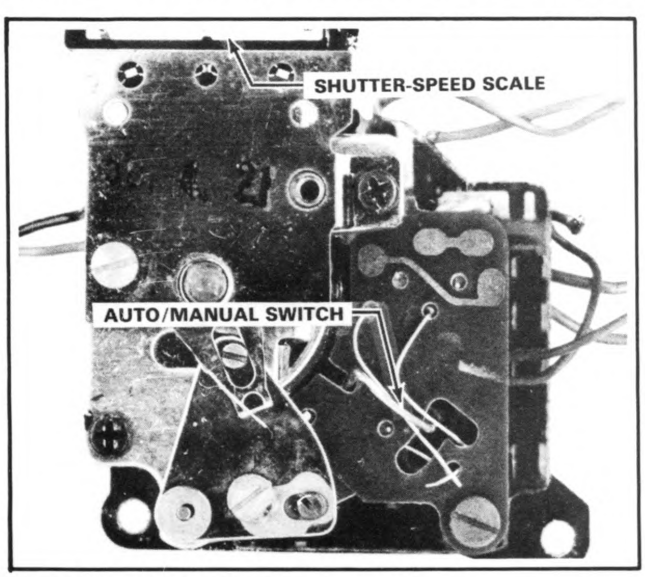


Figure 54 Auto setting

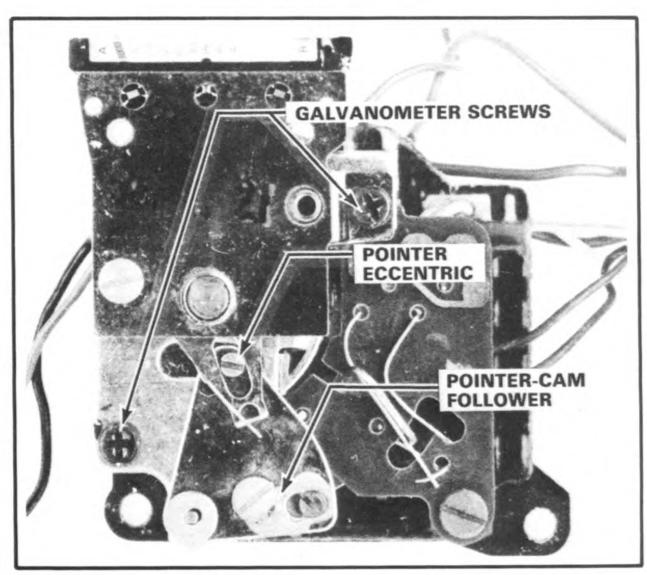


Figure 55 Manual setting

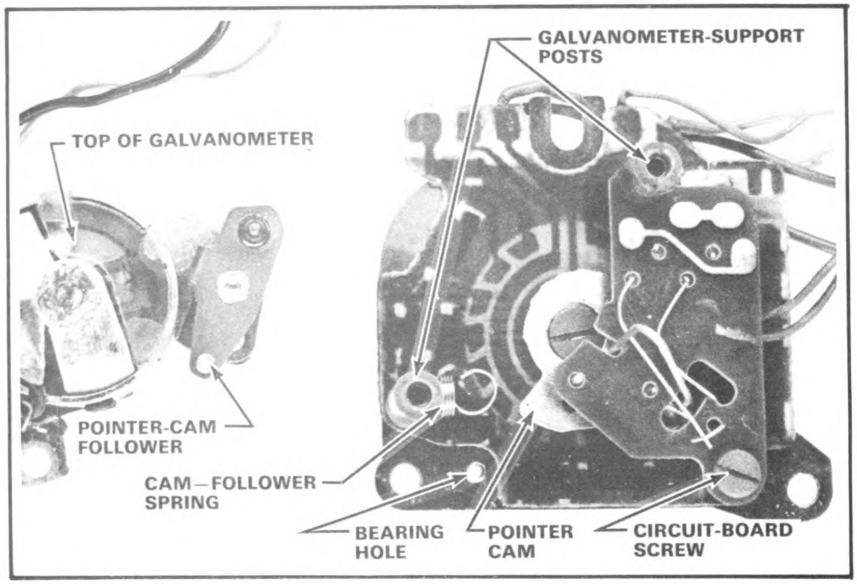


Figure 56

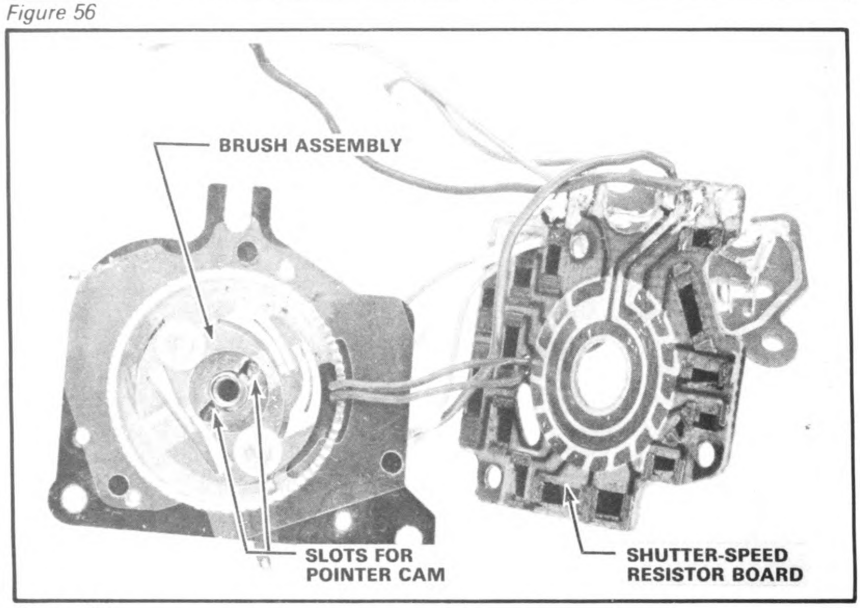


Figure 57

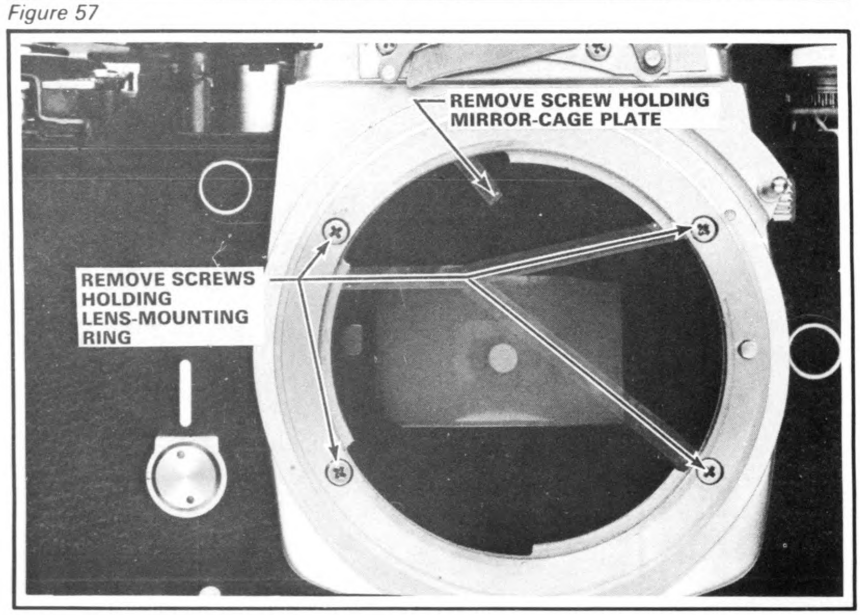


Figure 58

resistors, you may be able to repair the speed selector. Cleaning the contact surfaces or reforming the brushes often corrects erratic resistance readings or even an apparent open.

Start by removing the galvanometer. The eccentric shown in Fig. 55 provides your adjustment for the green pointer. By turning the eccentric, you can precisely align the pointer with the shutter-speed calibrations. The lower end of the pointer-cam follower, Fig. 55, rides against the pointer cam.

You can barely see the pointer cam under the auto/manual circuit board. But you can reach the tension-type spring that connects to a lug on the pointer-cam follower. The other end of the spring connects to a groove in one of the galvanometer-support posts.

Disconnect the spring from the pointer-cam follower. Then, remove the two screws shown in Fig. 55 and lift out the galvanometer assembly. On reassembly, make sure the pointer-cam follower rides against the outside edge of the pointer cam, Fig. 56. Also, the pivot on the pointer-cam follower must pass into the bearing hole in the speed-selector mechanism plate.

Notice that the spring for the pointer-cam follower remains on one of the galvanometer-support posts, Fig. 56. The groove in the other galvanometer-support post supports one edge of the auto/manual circuit board.

Unscrew both of the galvanometer-support posts from the speed-selector mechanism plate. Then, take out the screw at the other end of the auto/manual circuit board, Fig. 56; there's a ceramic spacer under this end of the circuit board.

Now, lift aside the auto/manual circuit board. Notice the insulator over the center wire of the auto/manual switch. The insulator passes through a slot in the shutter-speed resistor board. At the automatic setting, a tab on the brush assembly comes against the insulator. That moves the center wire to the automatic position, Fig. 54.

A central screw holds the pointer cam. Remove the screw and the compression spring for the speed-knob lock. Then, remove the pointer cam and lift aside the shutter-speed resistor board, Fig. 57.

You can now clean the brushes and the resistor contacts, Fig. 57. In Fig. 57, notice the two slots in the center of the brush assembly -- two tabs on the pointer cam must pass into these slots. It's possible, then, to replace the pointer cam 180° out of time.

At the automatic setting, the largest lobe of the pointer cam should point to

the edge of the shutter-speed mechanism plate -- the edge opposite the U-shaped cutout, Fig. 57. So, after replacing the shutter-speed resistor board, set the speed knob to the automatic position. Then, replace the pointer cam with its large lobe pointing away from the U-shaped cutout. Insert the compression spring for the speed-knob lock through the center of the brush assembly and replace the pointer-cam screw.

Before replacing the auto/manual circuit board, set the speed knob to a manual shutter-speed setting. The insulated wire of the auto/manual switch then passes freely through the slot in the shutter-speed resistor board.

TESTING AND ADJUSTING THE MIRROR-CAGE SWITCHES

Earlier, we briefly described the operation of the memory system. And we mentioned that you can both check and adjust the mirror-cage switches without removing the mirror-cage/front-plate assembly.

The adjustments for the two mirror-cage switches (the memory switch and the power switch) are under the lens-mounting ring. You don't have to remove the lens-mounting ring to check the switches. However, in the event that you do have to adjust the switch timing, we'll first describe the disassembly required to reach the adjustment points.

Remove the focusing screen by taking out the upper mirror-cage plate as described earlier, Fig. 58. Then remove the lens-mounting ring by taking out its four screws, also shown in Fig. 58.

Locate the detent spring in Fig. 59. The detent spring provides the click-stop setting for the metering ring. When you turn the metering ring to the lens-removal position, the detent spring drops into the notch as shown in Fig. 59.

Take out the detent spring. Then, remove one of the screws from each of the three bayonet-mount springs, Fig. 59. Just loosen the other three screws; you can then turn the bayonet-mount springs to clear the metering ring, Fig. 60. Tighten each of the screws shown in Fig. 60 to hold the bayonet-mount springs in place.

Be careful as you lift out the metering ring -- there's a tension-type spring which fits within a groove on the underside of the metering ring, Fig. 61. One end of the compression spring hooks to a post on the metering ring; the other end hooks to a post on the ratchet ring, Fig. 61. Disconnect the end of the spring from the ratchet-ring post and lift out the metering ring.

Now, remove the four screws holding the lens seat, Fig. 62. After lifting out the

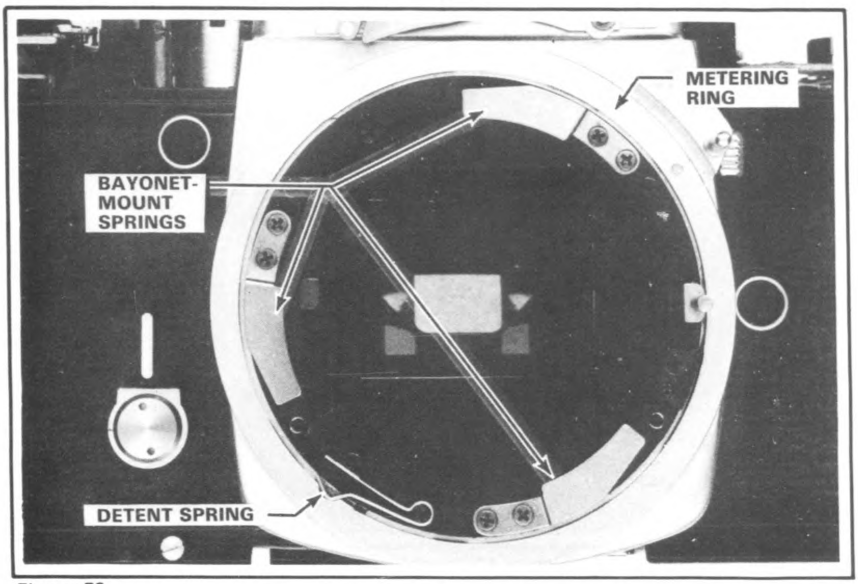


Figure 59

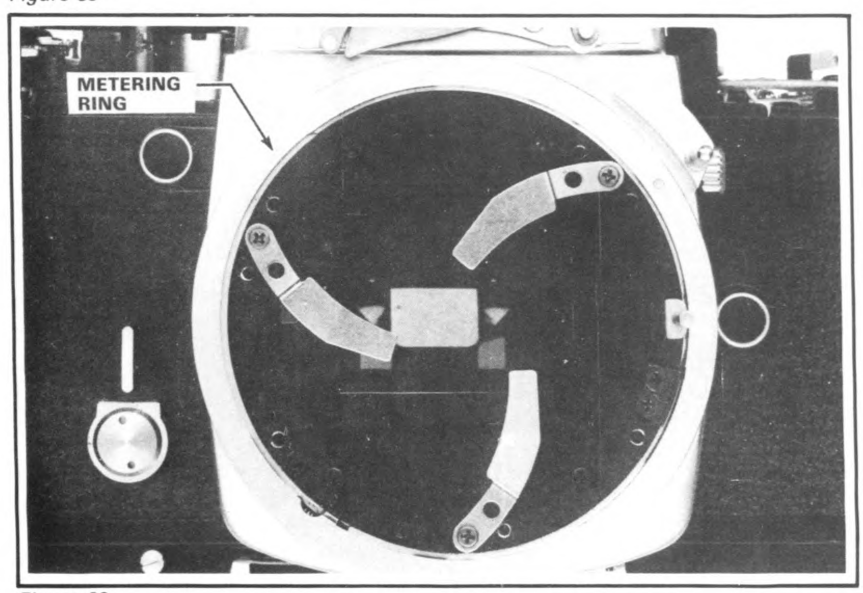


Figure 60

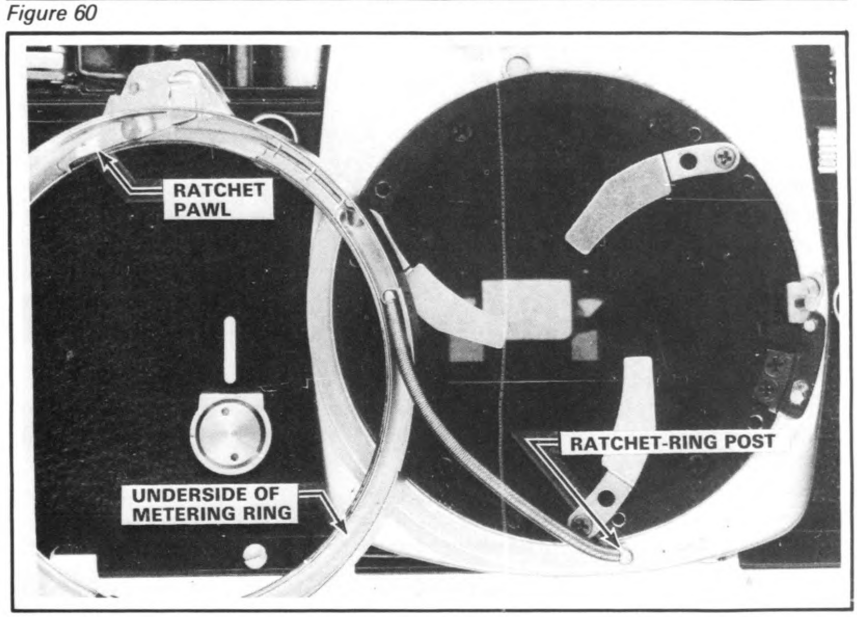


Figure 61

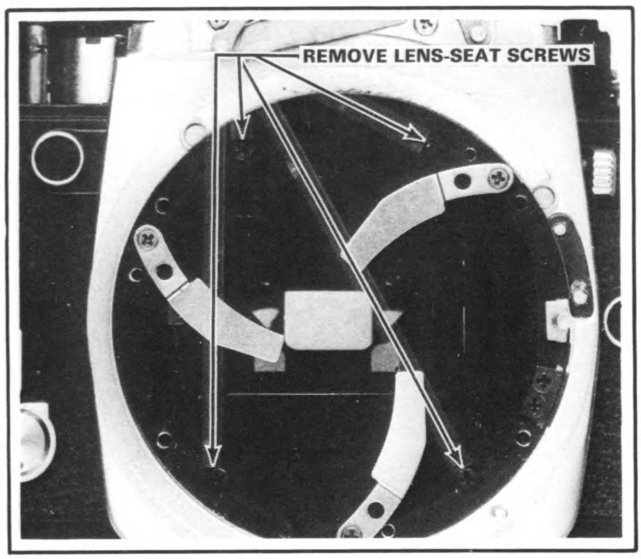


Figure 62

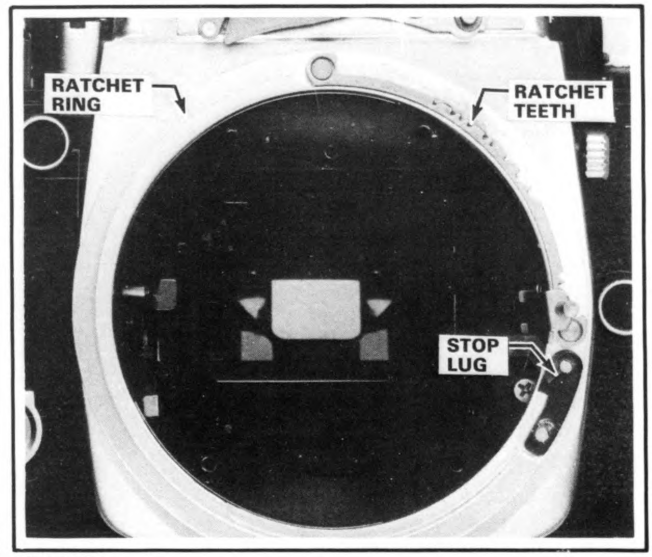


Figure 63

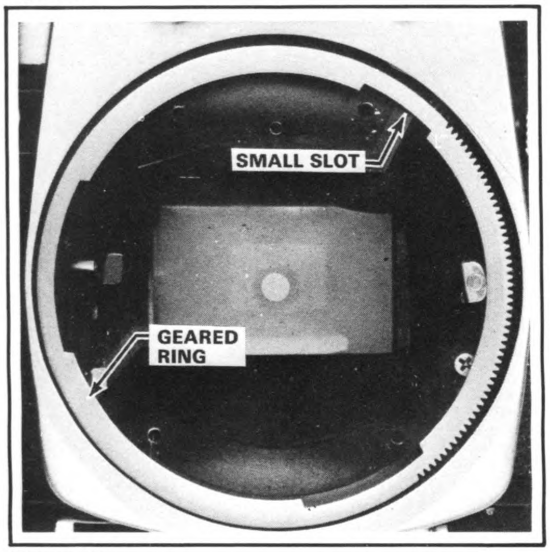


Figure 64

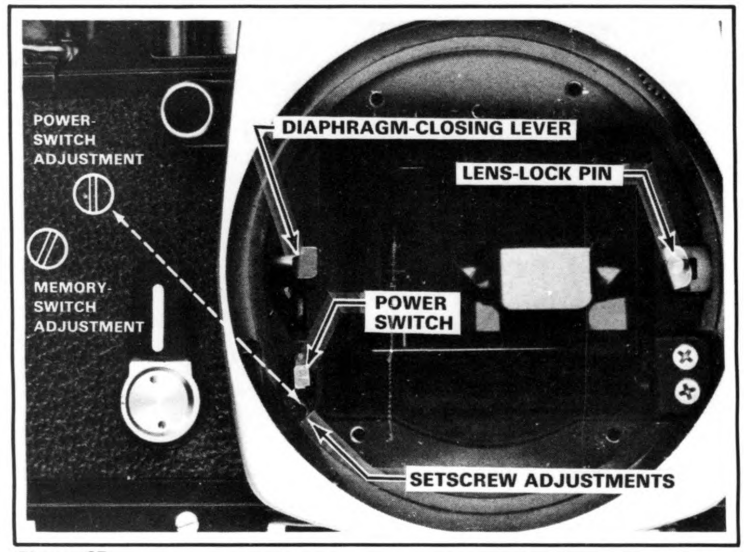


Figure 65

lens seat, you can see the ratchet ring, Fig. 63. The spring-loaded ratchet pawl at the back of the metering ring, Fig. 61, normally engages the teeth of the ratchet ring. So, as the metering ring rotates, the ratchet ring turns in the same direction.

During reassembly, we'll cover the operation and test procedures of the rings. For now, lift out the ratchet ring and notice the three tabs on its back surface. These tabs fit into the three slots in the geared ring, Fig. 64.

One of the three geared-ring slots is smaller in width than are the other two, Fig. 64. Also, one of the three tabs at the back of the ratchet ring is smaller in width than are the other two tabs. Consequently, there's only one way the ratchet ring will key to the geared ring -- the small ratchet-ring tab passes into the small geared-ring slot. You can't reassemble the two rings incorrectly.

The geared ring is the part that actually turns the functional-resistor brush. You can now lift out the geared ring. But doesn't this disturb the timing of the functional resistor?

It sure does. However, you'll find that you can most easily retime the parts from the top of the camera. Trying to precisely retime the rings from the front of the camera can be pretty tough. So, after we go through the reassembly, you can assume that the functional resistor will be out of time. As the final step in the reassembly, just remove and retime the functional resistor as previously described.

After removing the geared ring, you can reach the switch adjustments, Fig. 65. However, you may also wish to lift out the lens-lock pin, Fig. 65, just to prevent loss. The lens-lock pin passes through a hole in the lens-mounting ring to lock the lens in place. Slots in the tab of the lens-lock pin simply fit through the fork of the lens-release button.

From the front of the mirror cage, you can now see the power switch, Fig. 65. The two setscrew adjustments are just below the power switch, also shown in Fig. 65. Each of the nylon setscrews contacts a switch. The setscrew on your left in Fig. 65 controls the memory switch, and the setscrew on your right controls the power switch.

To adjust the power switch, first disconnect the gray wire from the battery-test circuit board, Fig. 66. Then, disconnect the gray wire at the front of the main circuit board, Fig. 67. The two gray wires connect to the power switch.

Now, cock the shutter. And connect an ohmmeter between the two gray wires. Fig. 68 shows the ohmmeter connection. Since the power switch should be open, your ohmmeter should show no continuity.

The power switch should close just before the mirror-lifting lever contacts the mirror. The mirror-lifting lever also drives down the diaphragm-closing lever,

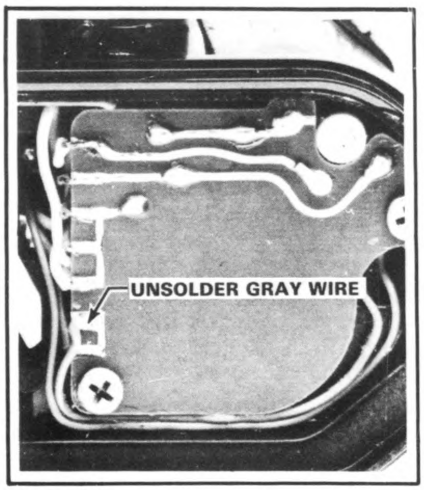


Figure 66

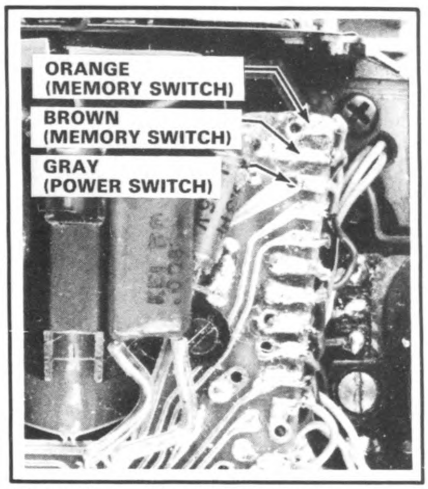


Figure 67 Unsolder these wires to check the mirror-cage switches

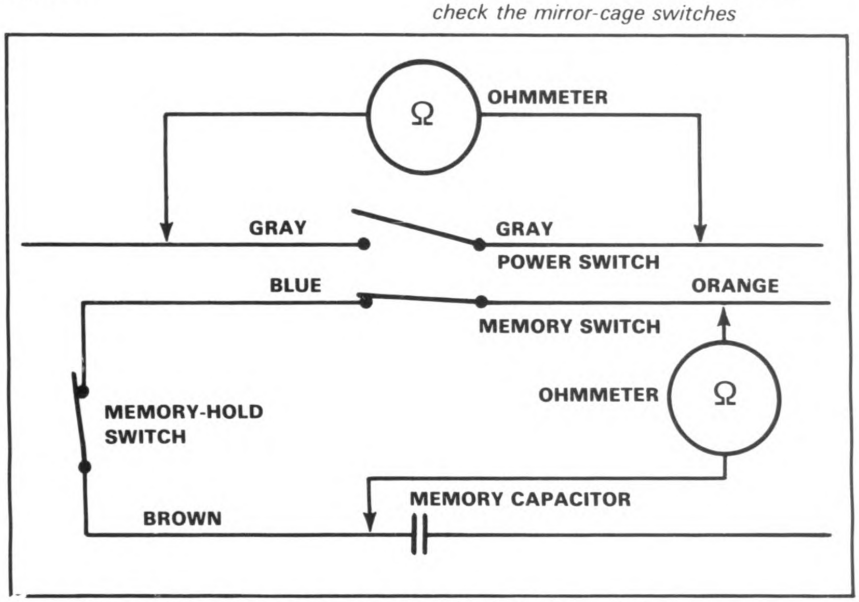


Figure 68 Ohmmeter connections to check mirror-cage switches

Fig. 65. So you can check the switch action by holding the diaphragm-closing lever as you release the shutter.

Try holding the diaphragm-closing lever as shown in Fig. 69. Then, push down the release rod and allow the diaphragm-closing lever to move down slowly. After the diaphragm-closing lever moves a slight distance, you can feel the mirror-lifting lever make contact with the mirror.

The power switch should close just before you feel the engagement. Again cock and release the shutter while holding the diaphragm-closing lever. This time, watch the ohmmeter as the diaphragm-closing lever moves down. The ohmmeter should show contact just before you feel the mirror-lifting lever engage the mirror.

If the power switch closes too soon or too late, you can adjust the setscrew, Fig. 65. Turning in the setscrew (clockwise) causes the power switch to close later (the diaphragm-closing lever moves down further before the power switch closes).

What if the power switch isn't closing? Then, the shutter will only deliver the mechanical speed -- regardless of the speed setting. If there's a problem with the power switch (other than the adjustment), you'll have to remove the front-plate/mirror-cage assembly.

Use a similar technique to test and adjust the memory switch. The memory switch should open when the diaphragm-closing lever is about half way between its starting position and the position where you feel engagement.

To check the memory switch, unsolder the brown wire and the orange wire from the main circuit board, Fig. 67. These are the two wires that connect to the memory switch, Fig. 68. Connect your ohmmeter between the two disconnected wires and repeat the test.

This time, the ohmmeter should show continuity before you push the release

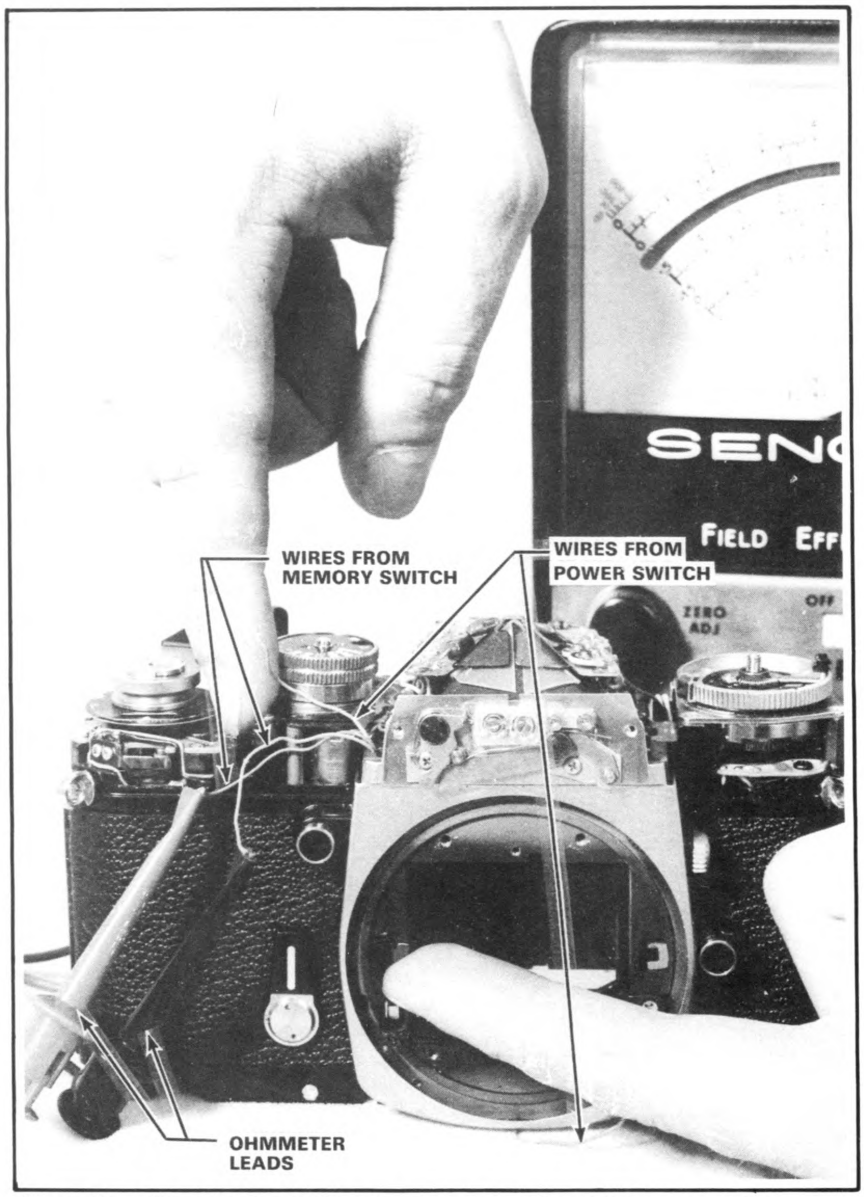


Figure 69 Procedure for testing the memory switch and the power switch

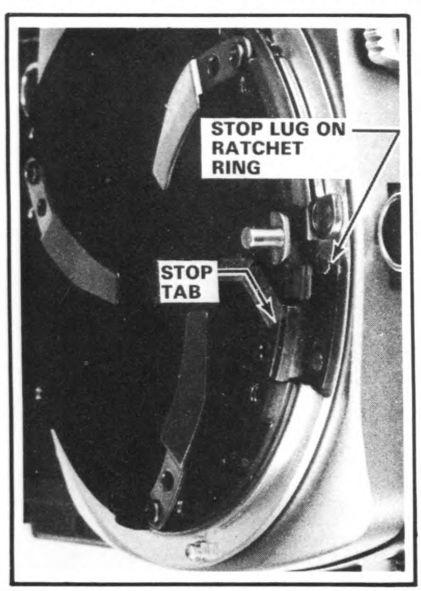


Figure 70

rod. Now, depress the release rod and allow the diaphragm-closing lever to move down slowly, Fig. 69. The memory switch should open, breaking the continuity, just before you feel the engagement of the mirror-lifting lever with the mirror.

Turning the memory-switch setscrew, Fig. 65, adjusts the closing of the memory switch. If you turn the setscrew clockwise, the memory switch will open later; if you turn the setscrew counterclockwise, the memory switch will open sooner.

However, if the memory switch fails to make good contact, you'll have to remove the front-plate/mirror-cage assembly. With a defective memory switch, you'll normally find that the shutter hangs open when set to automatic. Yet the manually set shutter speeds work properly.

REASSEMBLY OF THE LENS-MOUNTING RING

Replace the lens lock pin, Fig. 65. Then, seat the geared ring as shown in Fig. 64. The teeth at the top of the geared ring engage a gear in the linkage system.

Key the small tab of the ratchet ring into the small slot of the geared ring. The ratchet ring should then seat as shown in Fig. 63. Now replace the lens seat, Fig. 62.

Check to make sure the ratchet ring turns freely. When you turn the ratchet ring as far as it will go in a clockwise direction, the stop lug, Fig. 63, comes against a stop tab on the lens seat. Fig. 70 shows the stop lug against the stop tab.

Hook the compression spring of the metering ring to the pin on the ratchet ring, Fig. 61. Make sure the compression spring passes around the outer edge of the lens seat (the left-hand edge as seen in Fig. 61) as you seat the metering ring.

Replacing the metering ring may be the trickiest part of the whole procedure. It's normally easiest, though, if you seat the right-hand edge of the metering ring first; the lip on the inner circumference of the metering ring must pass under the stop lug and the lens-lock pin. Then, use a screwdriver blade to help the metering-ring spring into place as you seat the metering ring.

If the metering ring still won't seat properly, depress the lug of the ratchet pawl (you can reach the ratchet-pawl lug just beneath the lug for the lens-coupling pin, Fig. 63). Depressing the ratchet-pawl lug moves the ratchet pawl away from the teeth of the ratchet ring. The metering ring should then seat fully.

You can now return the bayonet springs to their proper positions. Make sure that the inner sides of the bayonet springs clear the inner circumference of the lens seat as you tighten the screws. Now check the freedom of the metering ring --turn the metering ring in both directions to assure that it rotates freely. If you feel any bind, you may have to shift the positions of the bayonet springs.

CHECKING AND ADJUSTING THE METERING RING

After replacing the metering ring, check for the proper acton of the "shuffle." Try turning the metering ring fully clockwise to the lens-removal position. The metering-ring lug then comes against a pin on the pawl-control lever, Fig. 71. The pawl-control lever should then swing counterclockwise until it's latched by the control-lever latch, Fig. 72.

The cam surface of the pawl-control lever, Fig. 72, is now in the path of the ratchet-pawl lug (the ratchet pawl is the

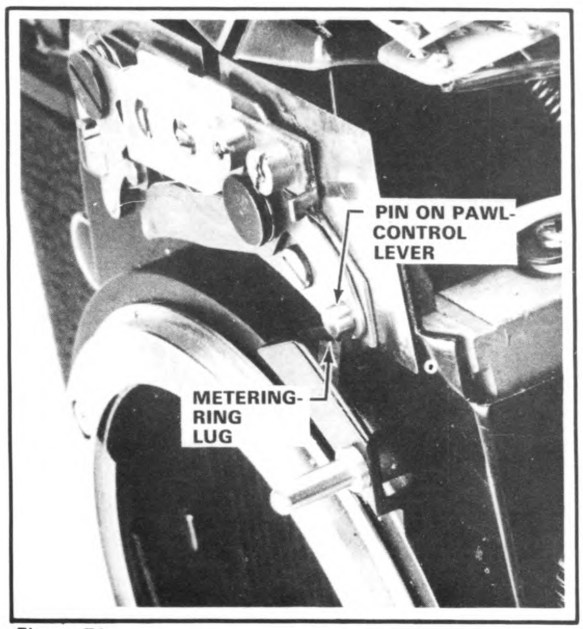


Figure 71

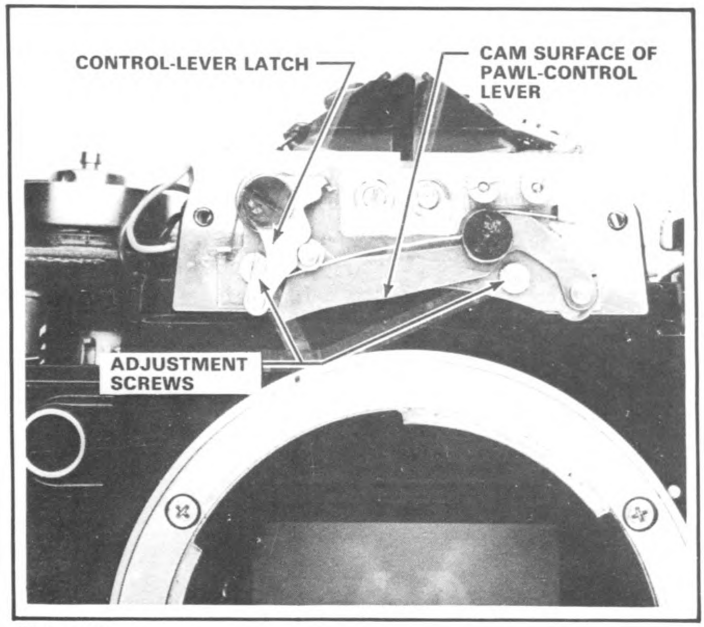


Figure 72

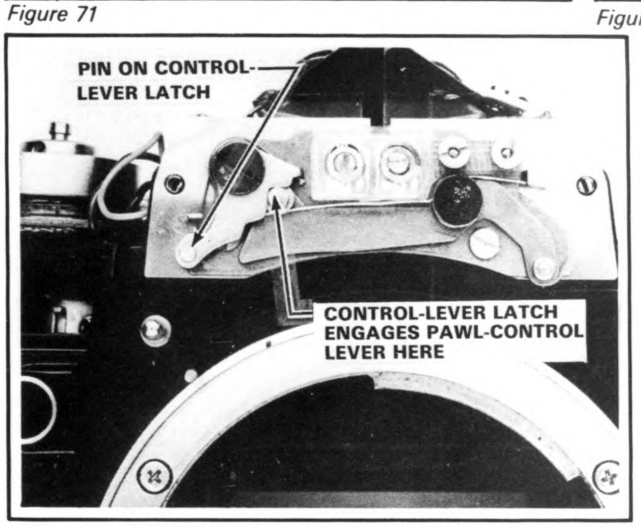


Figure 73

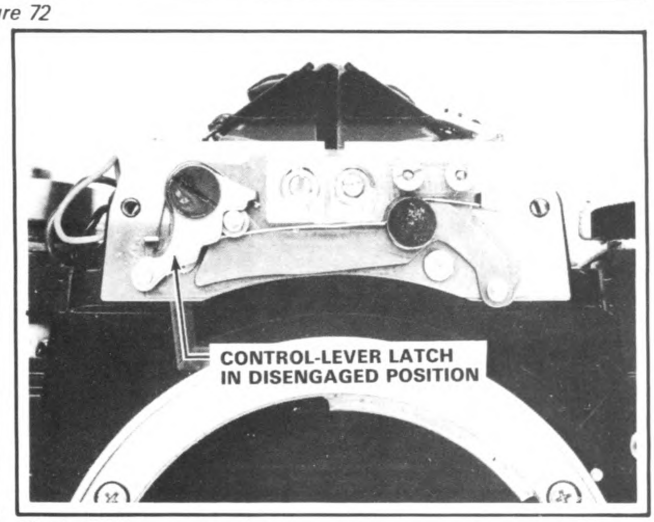


Figure 74

spring-loaded pawl on the metering ring that engages the teeth of the ratchet ring, Fig. 61). Next, rotate the metering ring in a counterclockwise direction -- that's the direction the metering ring turns when you set the smallest f/stop.

As the metering ring rotates counterclockwise, the ratchet-pawl lug comes against the cam surface of the pawl-control lever. The cam surface then pushes the ratchet pawl away from the teeth of the ratchet ring. Remember there's a tension-type spring hooked between the ratchet ring and the metering ring. So, once the ratchet pawl disengages, the spring drives the ratchet ring in a clockwise direction. You can hear the "click" as the ratchet ring strikes the stop lug on the lens mount.

The metering-ring lug then comes against the downward-projecting pin of the control-lever latch, Fig. 73. Now, the metering ring disengages the control-lever latch from the pawl-control lever. And the spring-loaded pawl-control lever swings clockwise to the position shown in Fig. 73. Notice that the cam surface of the pawl-control lever is no longer in the path of the metering ring.

Next, rotate the metering ring in a clockwise direction (the direction that the metering ring turns as you set the largest f/stop). You should hear the ratchet pawl click into engagement with the ratchet ring. The ratcheting sound continues as the metering ring rotates clockwise.

If a lens were installed, it would limit how far you could turn the metering ring in a clockwise direction. The maximum aperture of the lens decides how far the metering ring can rotate. That, in turn, determines which tooth of the ratchet ring engages the ratchet pawl.

The ratchet pawl now locks the ratchet ring to the metering ring. And the position of the ratchet ring (with respect to the metering ring) has been established by the lens. As the metering ring rotates through the f/stop range, it carries the ratchet ring. In turn, the ratchet ring rotates the geared ring, Fig. 64.

Notice that you can adjust the position of the plate which supports the pawl-control lever and the control-lever latch, Fig. 72 (Fig. 72 shows a fairly early model of the EL which has two slotted screws holding the adjustment plate -- later models, such as the one shown in fig. 65, use cross-point screws). Loosening the two screws allows you to shift the adjustment plate. The adjustment positions the pawl-control lever and the control-lever latch with respect to the metering ring.

To make the adjustment, first loosen the two screws, Fig. 72. Then, push the pawl-control lever to the disengaged position, Fig. 73. Rotate the metering ring until its lug is against the pin of the pawl-control lever, Fig. 71. Now, shift the adjustment plate until the pawl-control lever just moves to the engaged position, Fig. 72, and tighten the two screws.

REMOVING THE FRONT-PLATE/ MIRROR-CAGE ASSEMBLY

Normally, it's not necessary to disassemble the metering rings at the front of the camera (unless you have to adjust the mirror-cage switches). You can troubleshoot the mirror-cage switches without removing the metering rings; just unsolder the wires and make the ohmmeter tests as we described earlier. If your tests pinpoint a problem to the memory switch or to the power switch, you'll have to remove the complete front-plate/mirror-cage assembly.

Leave the speed selector in place. But remove the functional resistor. The gearing to the functional resistor remains with the front plate.

There are quite a few wires to unsolder (that's why it's helpful to locate the problem before removing the front-plate/mirror-cage assembly). First, unsolder the gray wire from the battery-test circuit board at the bottom of the camera, Fig. 75.

Also unsolder the two green sync wires from the shutter circuit board, Fig. 47, and the white bulb-switch wire from the

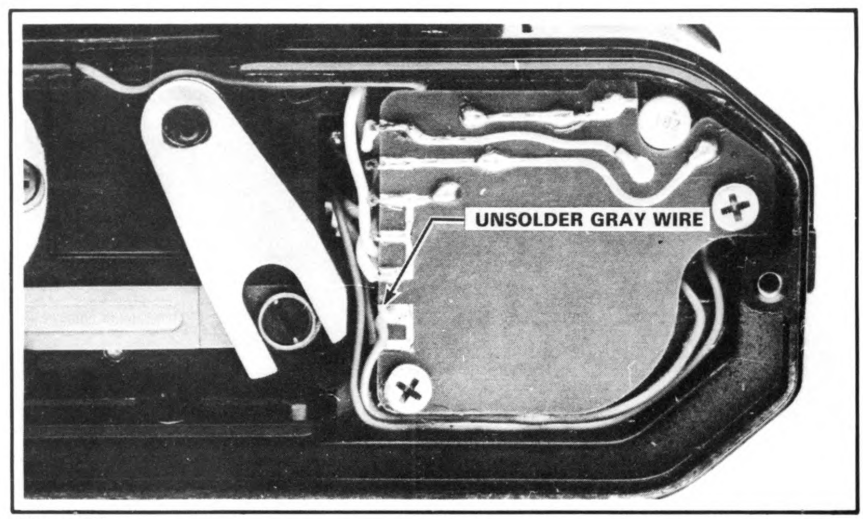


Figure 75

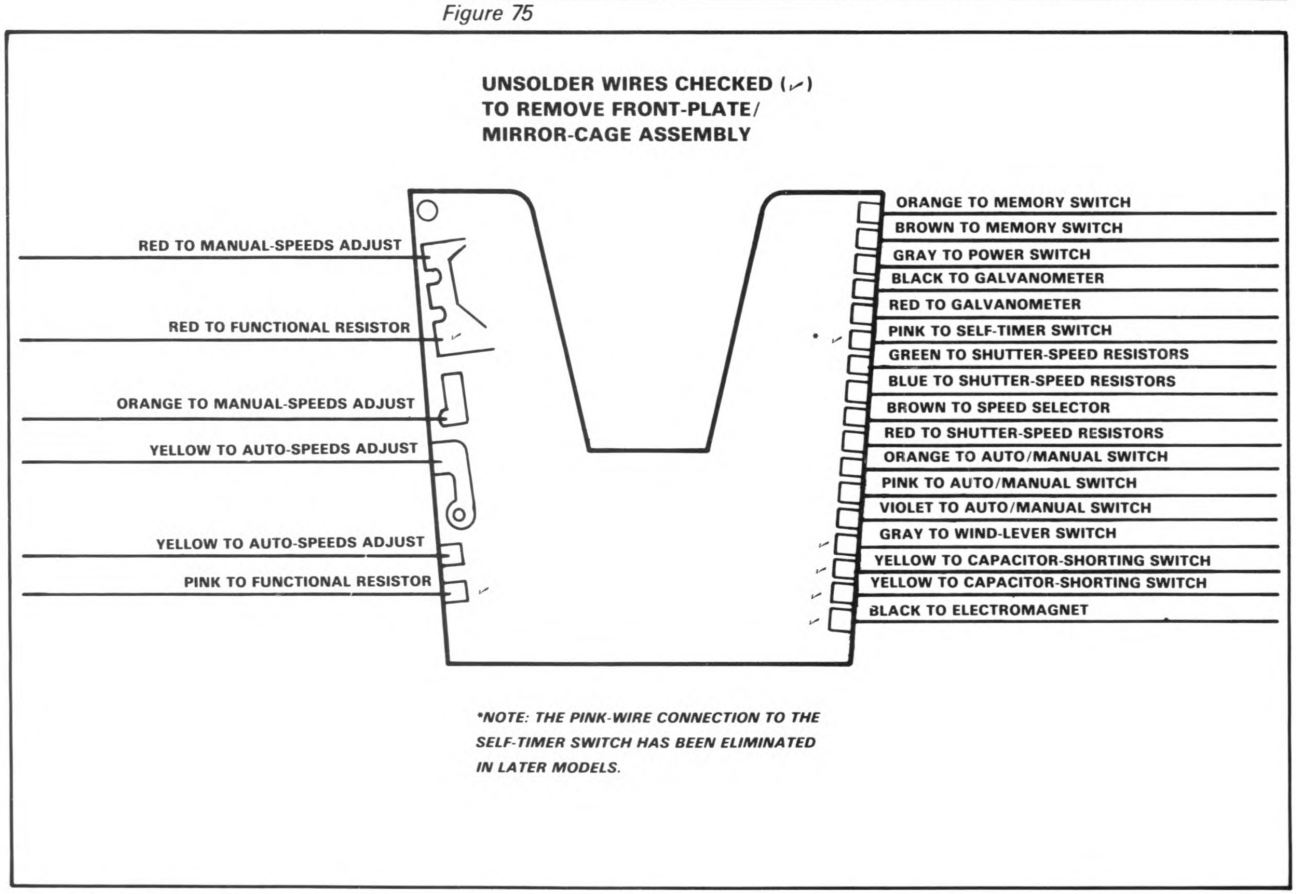


Figure 76 Main circuit board

speed-resistor circuit board, Fig. 48. Now unsolder the wires indicated in Fig. 76 from the main circuit board. These wires are:

- the pink wire and the red wire that come from the functional resistor
- the pink wire that comes from the self-timer switch
- the gray wire that comes from the wind-lever switch
- the two yellow wires that come from the capacitor-shorting switch
- the black wire that comes from the electromagnet.

Next, take out the speed-selector screw indicated in Fig. 77. Also remove the mirror-cage screw just behind the speed selector, shown in the same illustration. Only the front-plate screws under the leatherette now hold the front-plate/mirror-cage assembly.

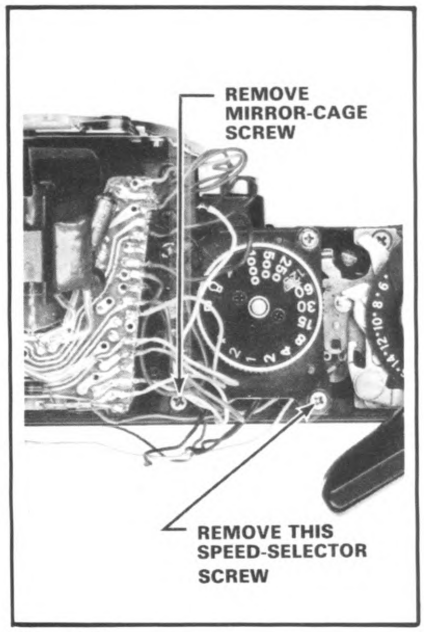


Figure 77

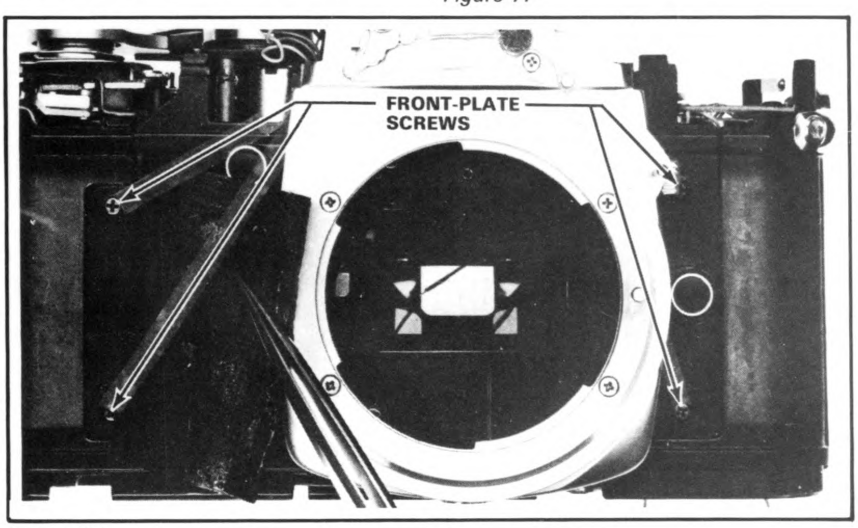


Figure 78

Peel off the front-plate leatherette on the rewind side of the camera. You don't have to completely remove the wind-side leatherette. Rather, just peel back the wind-side leatherette far enough to reach the two screws shown in Fig. 78; peel up the bottom of the leatherette to reach the screw shown in Fig. 79.

The wind-side leatherette then remains with the front-plate/mirror-cage assembly. By using the technique illustrated here, you don't have to remove the delayed-action (self-timer) cocking lever. And that saves a few seconds of disassembly-reassembly time. On reassembly, you can normally reactivate the old adhesive with acetone.

Now, lift out the front-plate/mirror-cage assembly. The gray wire you unsoldered from the battery-test circuit board remains with the front plate; this is one of the wires connecting to the power switch.

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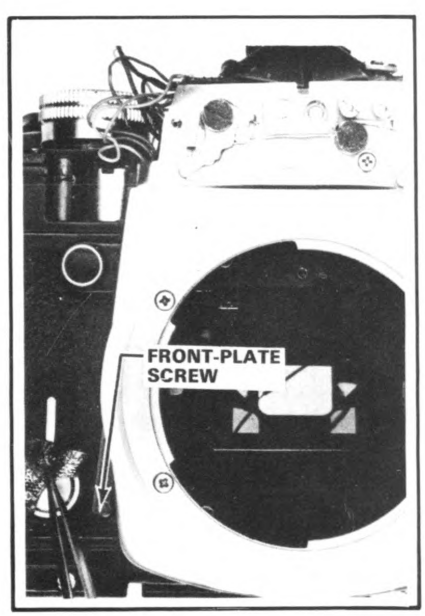
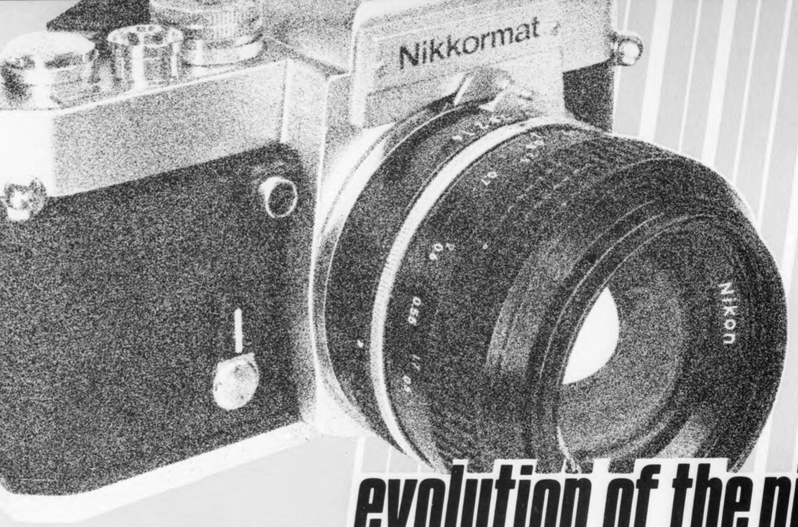


Figure 79



evolution of the nikkormat el

Part III by Larry Lyells

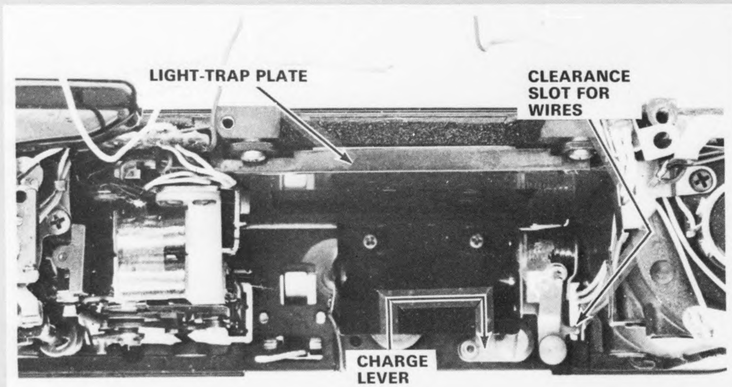


Figure 80

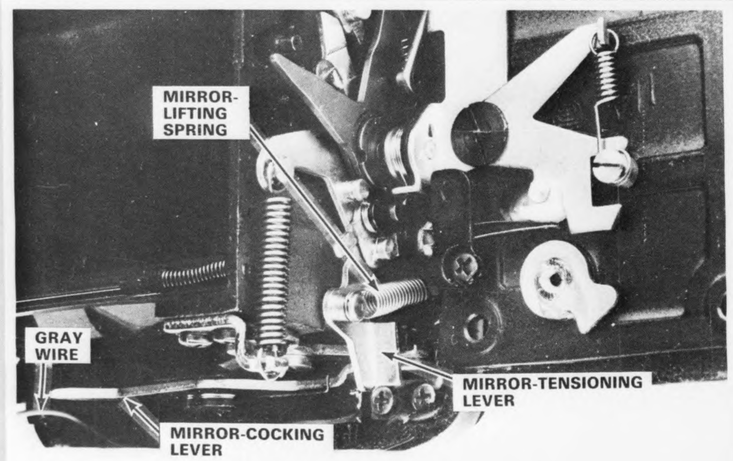


Figure 82

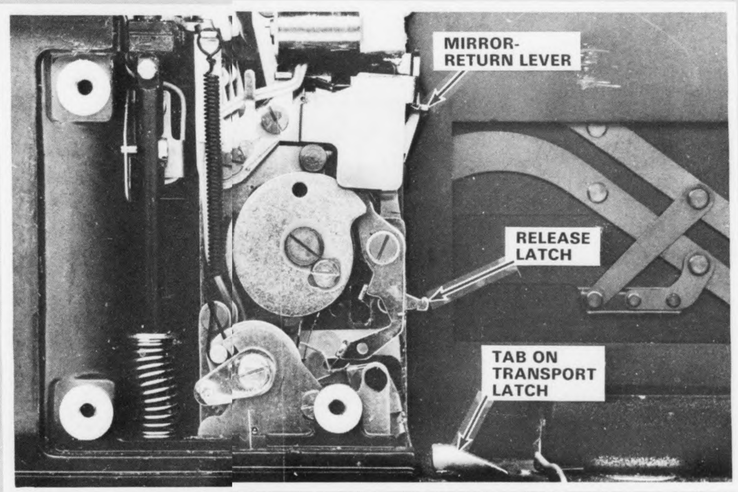


Figure 81

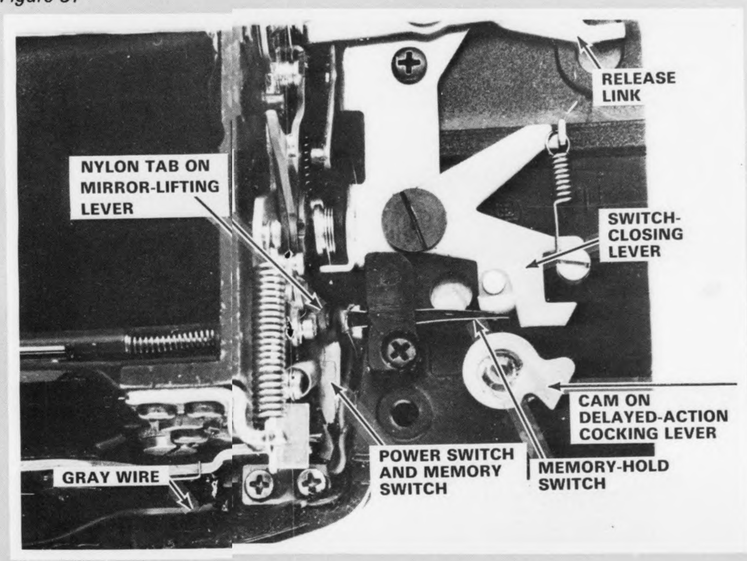


Figure 83

REPLACING THE FRONT-PLATE/MIRROR-CAGE ASSEMBLY

After removing the front-plate/mirror-cage assembly, watch for the loose light-trap plate, Fig. 80. The light-trap plate straddles the top edge of the shutter-blade assembly.

There's one trick to replacing the front-plate/mirror-cage assembly: *Both the shutter and the mirror cage must be in the cocked positions.*

But you'll now find that you can't cock the shutter. Without the mirror cage, there's nothing to disengage the transport latch. Fig. 81 shows the extension on the transport latch, the tab that's normally controlled by the mirror mechanism. Hold the tab toward the front of the camera as you advance the wind lever. If you're testing the operation, you can release the shutter by pushing up the release latch, Fig. 81.

Cock the mirror cage by pushing the mirror-cocking lever, Fig. 82, in a counterclockwise direction (as seen from the bottom of the mirror cage). In normal operation, the charge lever at the bottom of the camera, Fig. 80, pushes forward the mirror-cocking lever. The charge lever couples to the cocking slide.

As you seat the mirror cage, feed the gray power-switch wire, Fig. 82, through the clearance slot in the body casting, Fig. 80. Then, with the mirror cage seated, push down the release rod. The shutter should release, giving you the mechanical speed. You then know that the front-plate/mirror-cage assembly is properly seated.

OPERATION OF THE MIRROR-CAGE SWITCHES

From the back of the front-plate/mirror-cage assembly, you can now see the switches. In Fig. 83, we've pulled off the cemented porous-plastic strip that runs across the lower edge of the front plate. Removing the porous-plastic strip allows you to reach the memory switch and the power switch.

Both the memory switch and the power switch remain pretty well obscured by the mirror-cage mechanism. But you can easily reach the memory-hold switch, Fig. 83. Pushing the delayed-action cocking lever toward the lens opening brings the cam, Fig. 83, against the switch-closing lever. As the switch-closing lever moves up, its nylon tab moves away from the memory-hold switch. The memory-hold switch then opens, locking the charge on the memory capacitor.

What if the memory-hold switch fails to make good contact? You'll then have the same malfunction as you would with a defective memory switch or memory capacitor. The shutter may hang open or deliver erratic exposures at the automatic setting.

To see how the other mirror-cage switches work, locate the nylon tab on the mirror-lifting lever, Fig. 83. The nylon tab comes against the two mirror-cage switches; it holds the memory switch closed while simultaneously holding the power switch open.

Fig. 83 shows the mirror cage in the tensioned position. Remember, you can tension the mirror cage by pushing the

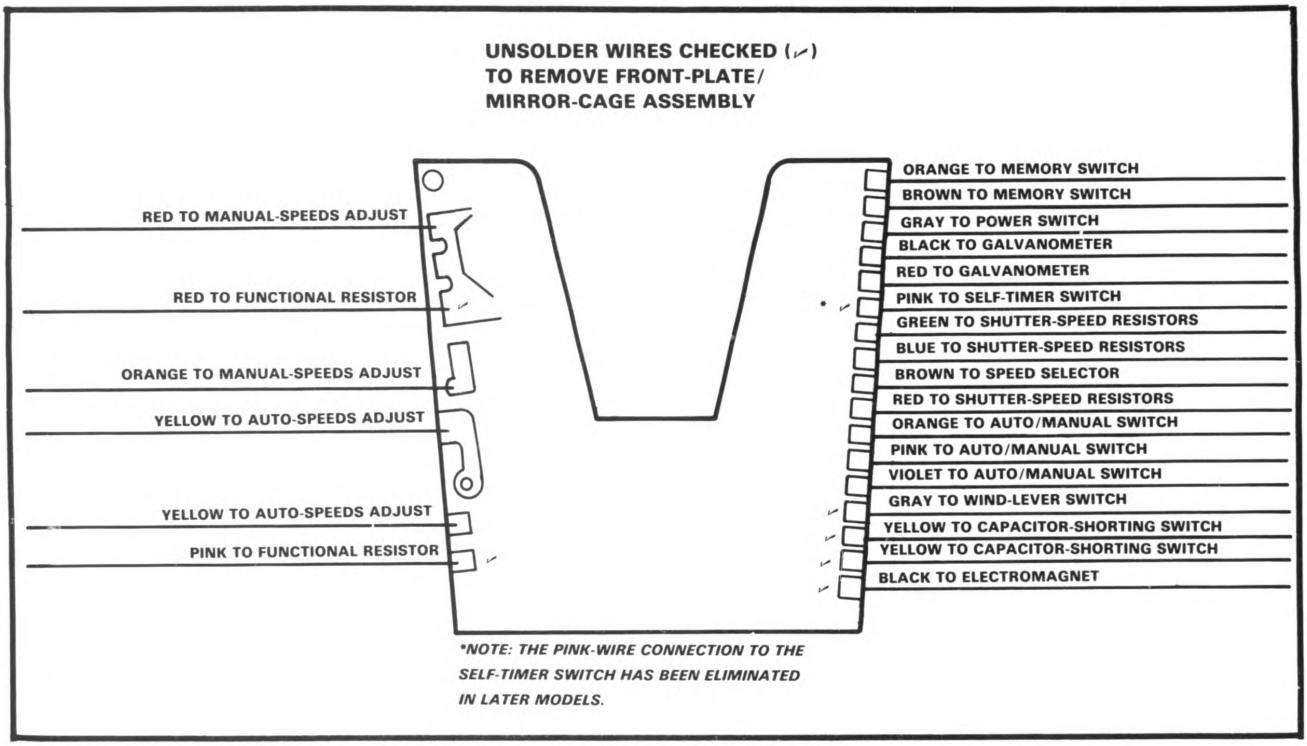


Figure 76 As a point of reference, this figure is repeated from part II of this article.

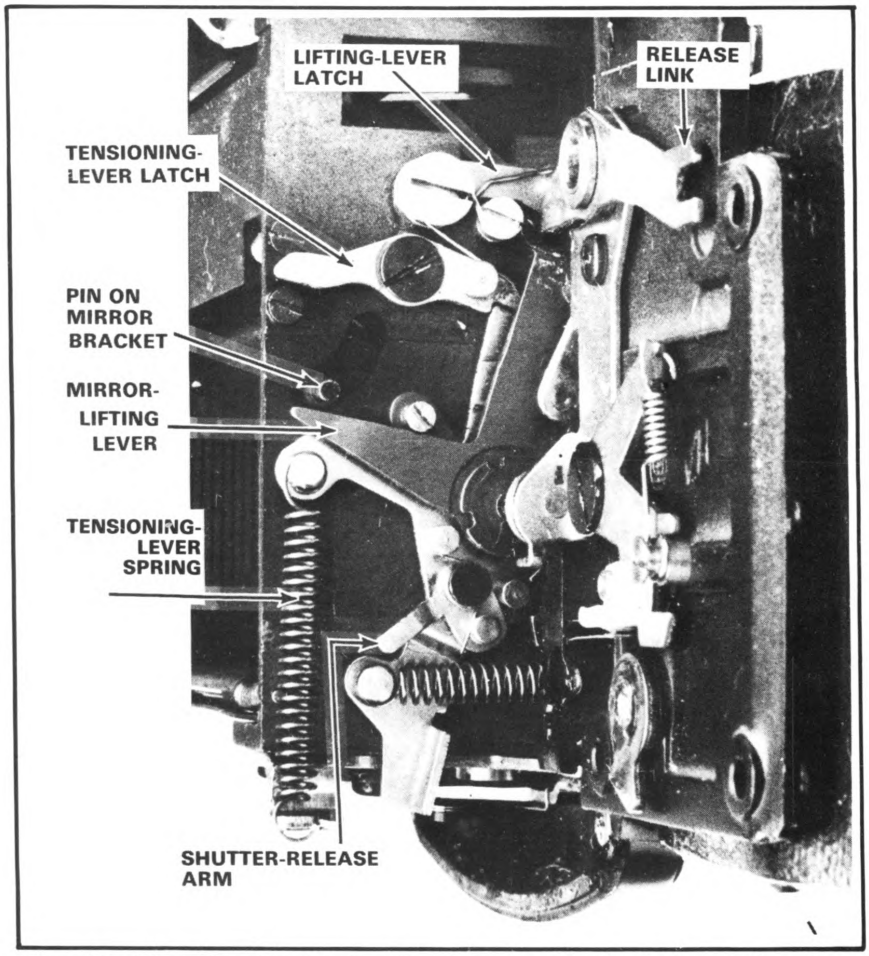


Figure 84 Mirror Cage Tensioned — The mirror returns to the viewing position when the mirror-return lever, Fig. 81, strikes the tensioning-lever latch. The shutter's closing-blade assembly drives the mirror-return lever.

mirror-cocking lever, Fig. 82, in a counterclockwise direction. The end of the mirror-cocking lever then drives the mirror-tensioning lever, Fig. 82, in a clockwise direction. At the end of the cocking cycle, the tensioning-lever latch engages the mirror-tensioning lever, Fig. 84.

The mirror-lifting spring, Fig. 84, is now tensioned. One end of the mirror-lifting spring hooks to the mirror-tensioning lever; the other end hooks to the mirror-lifting lever.

To release the mirror, push down the forked end of the release link, Fig. 84. The release link then disengages the lifting-lever latch, the latch which holds the mirror-lifting lever, Fig. 84. The mirror-lifting lever now rotates in a clockwise direction. An extension of the mirror-lifting lever comes against a pin on the mirror bracket, driving the mirror to the taking position. The mirror-lifting lever also strikes the shutter-release arm, Fig. 84, to release the shutter; the shutter-release arm disengages the release latch, Fig. 81.

As the mirror-lifting lever moves clockwise, its nylon tab frees the two mirror-cage switches. Now, the two switches go into action -- the memory switch opens and the power switch closes.

Fig. 85 shows how the nylon tab controls the memory switch. The moving contact wants to spring away from the fixed contact. However, in Fig. 85A, the nylon tab on the mirror-lifting lever holds

the memory switch closed. When the mirror moves to the taking position, the nylon tab swings away from the moving contact as shown in Fig. 85B. The memory switch then opens.

Notice the adjusting setscrew in Fig. 85; this is the setscrew you can reach from the front of the camera to time the memory switch. Since the adjusting setscrew positions the adjustable contact, it decides the exact moment at which the memory switch opens. Again, the memory switch should open just before the mirror-lifting lever strikes the mirror-bracket pin, Fig. 84.

Unlike the memory switch, the power switch is normally open, Fig. 86. A tab on the moving contact sits to the front of the adjustable contact. When the nylon tab on the mirror-lifting lever swings away from the power switch, the moving contact moves toward the back of the camera, Fig. 86B. The tab on the moving contact then comes against the adjustable contact. That closes the power switch, providing power to the shutter circuit for as long as the mirror remains in the taking position.

The power-switch adjusting setscrew positions the adjustable contact, Fig. 86. Remember, the power switch should close just before the mirror-lifting lever strikes the mirror-bracket pin. But your adjustment here is very delicate. Turning the adjusting setscrew too far in either direction, Fig. 86, may cause the power switch to remain constantly closed.

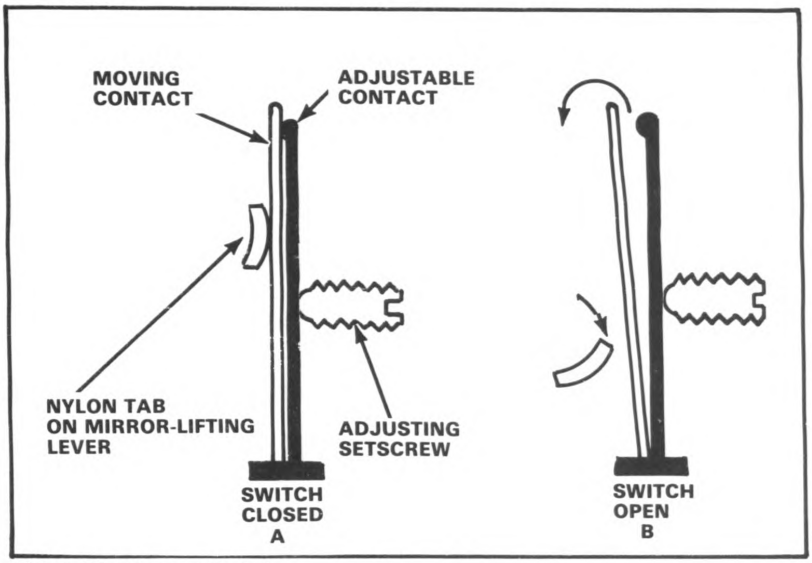


Figure 85 Memory Switch

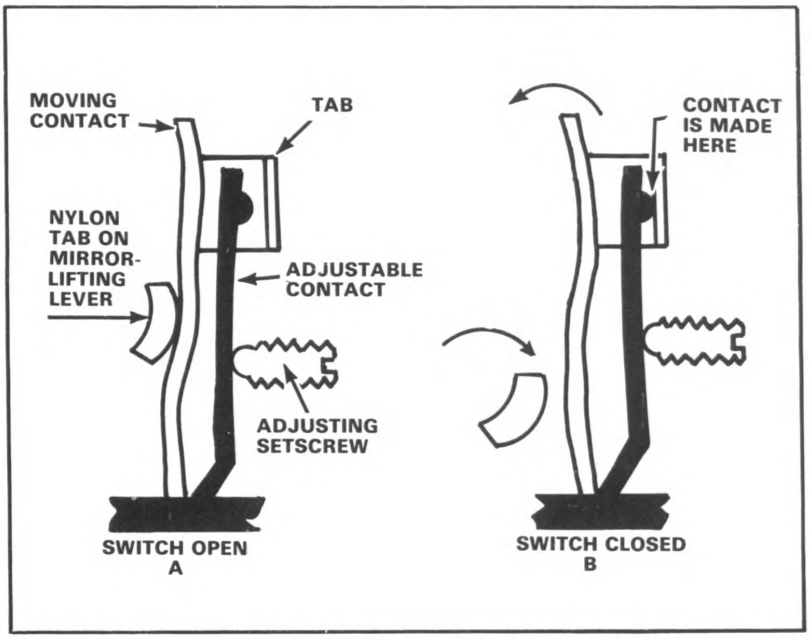


Figure 86 The power switch has a center contact which is not shown here. The center contact connects electrically to the moving contact.

CLEANING THE MIRROR-CAGE SWITCHES

As indicated earlier, poor contact in the memory switch may cause the shutter to hang open at the automatic setting. Or you may get erratic operation on the automatically controlled shutter speeds. Poor contact in the power switch normally causes the shutter to deliver only the mechanical speed, regardless of the speed-knob setting.

You can use a contact cleaner or a pure solvent (such as Freon) to clean the mirror-cage switches. Some people clean the switches without removing the switch assembly; others completely disassemble the switches for cleaning. Since you're cramped for space around the mirror-cage switches, though, you can do a better cleaning job by first removing the switch assembly.

It's easier to remove the switches if you first get the mirror-cocking lever and the tensioning-lever stop out of your way. Disconnect the spring from the mirror-cocking lever, Fig. 87. Then, remove the shoulder screw, Fig. 87, and lift the mirror-cocking lever from the camera.

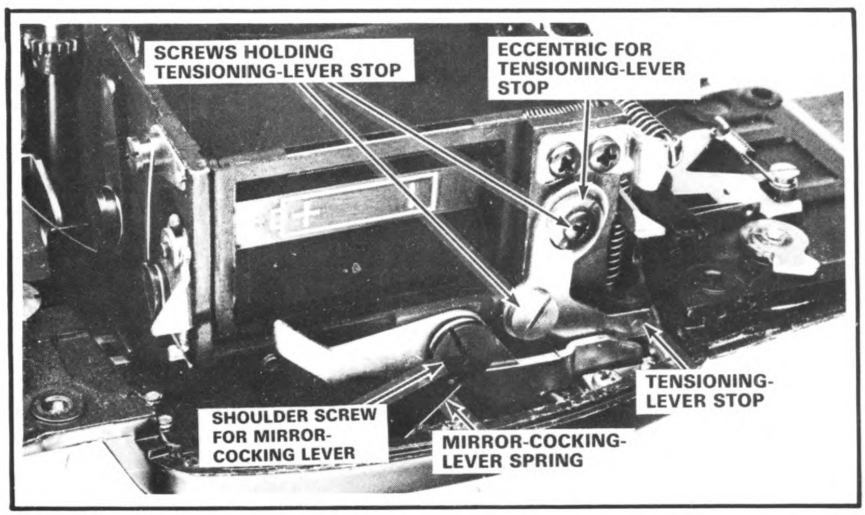


Figure 87

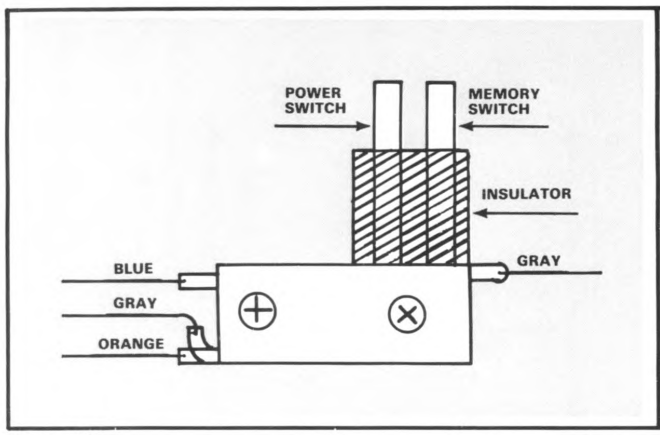


Figure 88

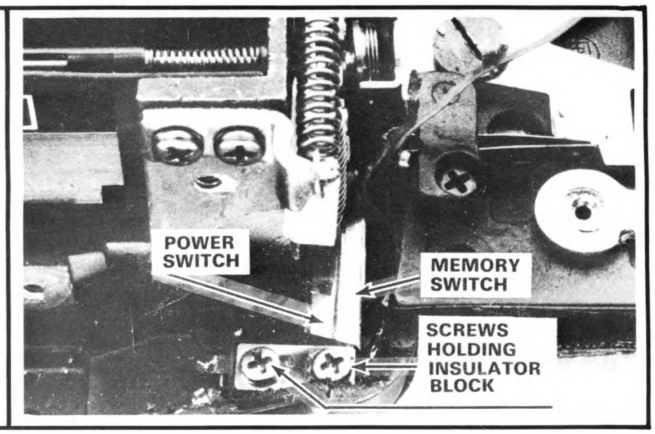


Figure 89

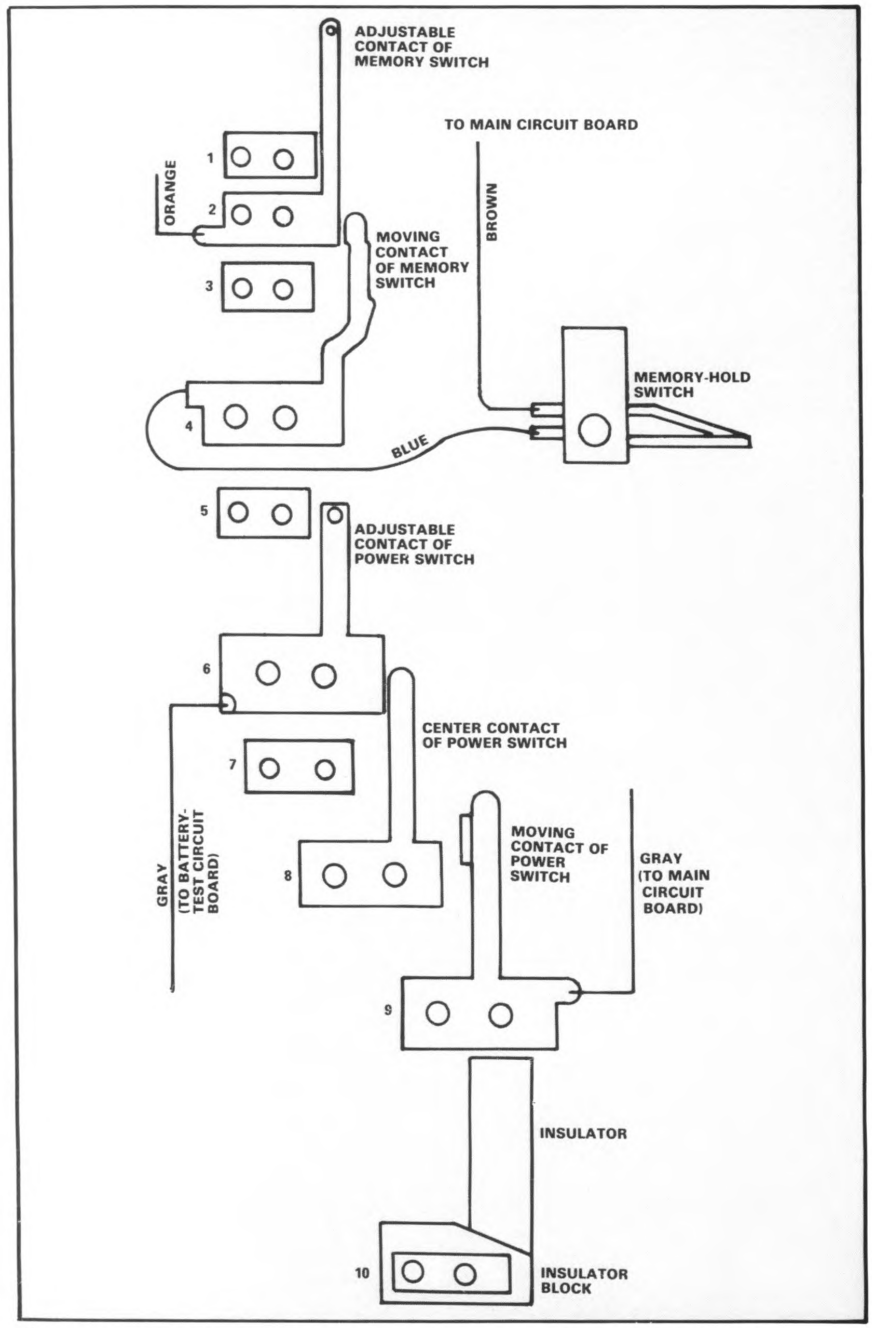


Figure 90 *Parts of mirror-cage switches numbered in sequence of installation.*

Two screws hold the tensioning-lever stop -- a shoulder screw and a cross-point screw which passes through an eccentric bushing. The eccentric adjustment controls how far the tensioning-lever stop allows the mirror-tensioning lever to move toward the front of the camera. Fortunately, there's quite a bit of locking agent on the eccentric adjustment. You can then remove the cross-point screw without disturbing the adjusted position. Take out the two screws shown in Fig. 87 and remove the tensioning-lever stop.

Now, cock and release the mirror cage. With the mirror in the taking position, you can more easily remove and replace the mirror-cage switches. Unsolder the wires from the switches, Fig. 88; since the wires are cemented to the front plate, you can leave them in place.

As you disassemble the mirror-cage switches, be careful of the insulator spacers. Rectangular spacers insulate the blades from one another. Remove the two screws holding the insulator block, Fig. 89. Notice that the insulator block has a strip of plastic; the plastic strip insulates the switches from the spring-hooking lug on the mirror-lifting lever.

Lift out the insulator block. The parts of the power switch may stick to the insulator block as you lift the assembly from the front plate. But the blades of the memory switch normally remain in the camera. Fig. 90 shows the reassembly sequence for the switches and the insulators.

SHUTTER IN THE EL

The Copal Square SE in the Nikkormat EL comes as a complete unit, including the electromagnet. You can see the electromagnet at the top of the shutter, Fig. 91.

If the electromagnet has an open, the shutter will only deliver the mechanical speed -- regardless of the speed-knob setting. You must then replace the complete

shutter assembly. To check the electromagnet, locate the two black electromagnet leads at the back of the shutter circuit board, Fig. 92. Measure the resistance between these two leads (you don't have to disconnect either wire). You should read the resistance of the electromagnet's coil -- 530Ω in our evaluation camera.

Fig. 91 also gives you a little better view of the bulb switch. An insulated post on the release rod holds the bulb switch in the closed position. When you depress the release rod, the bulb switch opens to prevent the timing capacitor from charging.

If the shutter operates at every setting except "bulb," make the bulb switch your first suspect. For example, suppose that the shutter hangs open on bulb -- it fails to close when you let up the release rod. That normally indicates poor contact in the bulb switch.

Also notice the wire connections to the front of the shutter circuit board, Fig. 91 and Fig. 93. The two yellow wires go to the capacitor-shorting switch, Fig. 94. You unsoldered the other ends of the yellow wires from the main circuit board to remove the front-plate/mirror-cage assembly.

In Fig. 94, we've partially cocked the shutter to more clearly show the capacitor-shorting switch. Here, you can also see the nylon eccentric; this is the eccentric that you can reach through a clearance hole in the front plate. Turning the eccentric affects the moment at which the capacitor-shorting switch opens, giving you a fast-speed adjustment.

The capacitor-shorting switch should be open when the shutter is in the released position. Cocking the shutter closes the capacitor-shorting switch. The capacitor-shorting switch now shorts across the timing capacitor on the main circuit board.

If the capacitor-shorting switch fails to open, the timing capacitor can't charge to the reference voltage which switches off the electromagnet's current. And the shutter hangs open. You can check the action of the capacitor-shorting switch by using your ohmmeter. Connect the ohmmeter between the two yellow leads, Fig. 93. With the shutter released, you should measure an open. Then, cock the shutter; your ohmmeter should show direct continuity.

A problem with either the capacitor-shorting switch or the electromagnet means you must remove the front-plate/mirror-cage assembly. However, you don't have to remove the front-plate/mirror-cage assembly to check

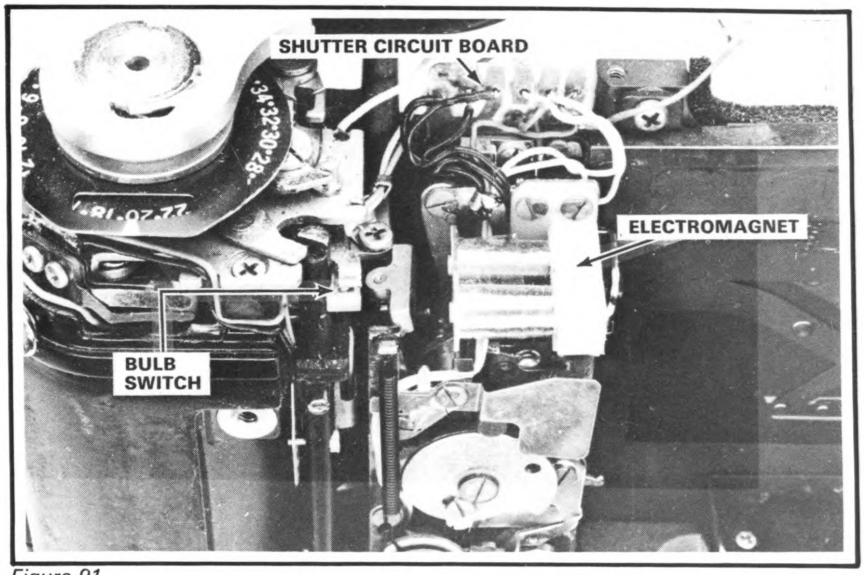


Figure 91

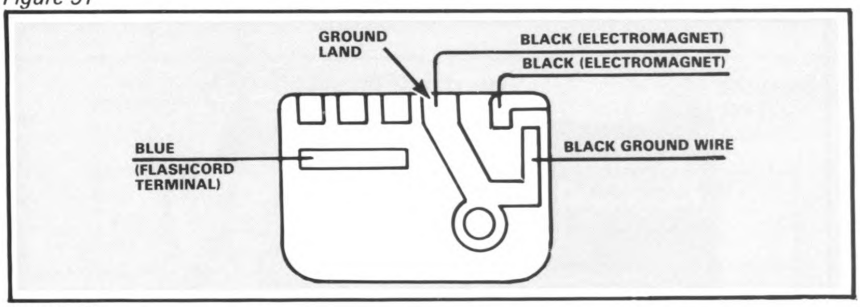


Figure 92

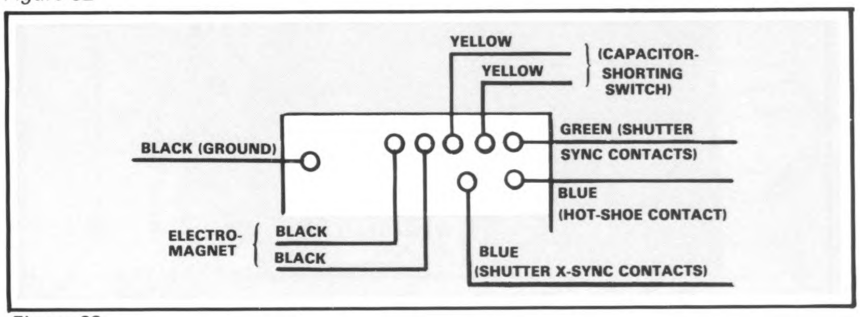


Figure 93

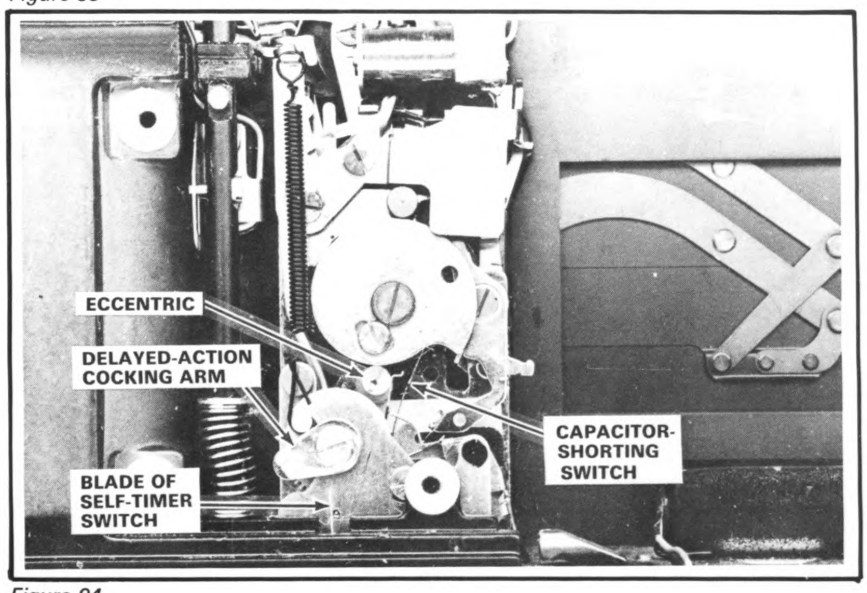


Figure 94

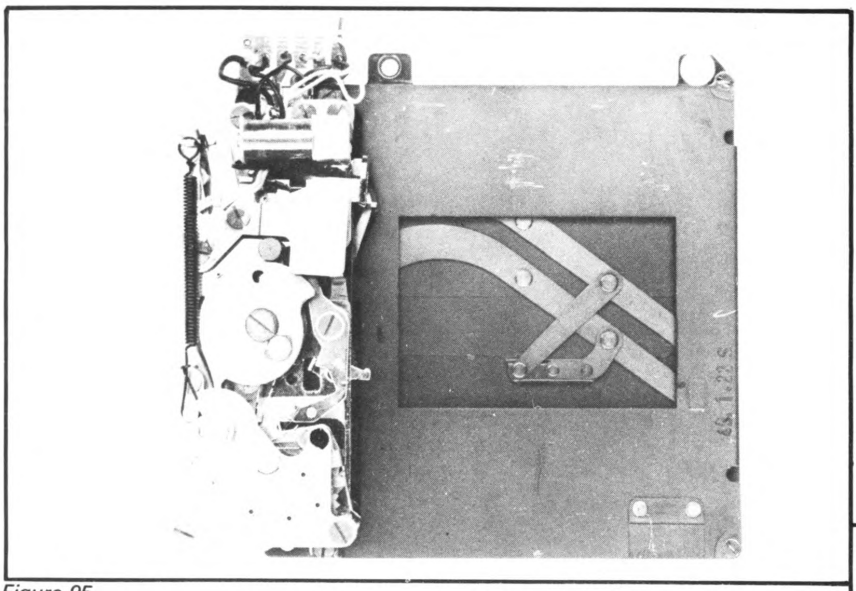


Figure 95

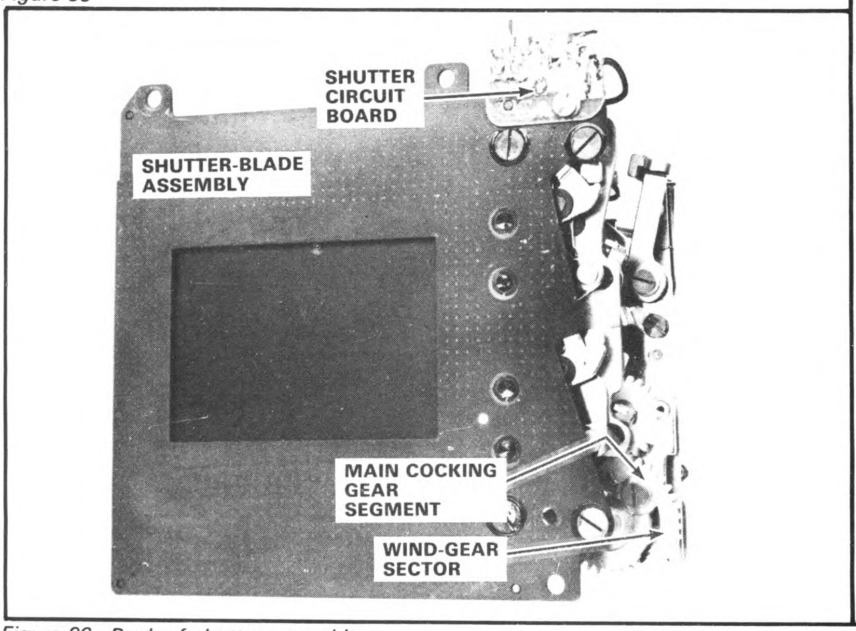


Figure 96 *Back of shutter assembly*

either component. Check the capacitor-shorting switch between the two yellow wires connected to the main circuit board, Fig. 76. And check the electromagnet between the two black wires connected to the shutter circuit board.

There's one switch we haven't as yet mentioned -- the self-timer switch, Fig. 94. When you cock the delayed-action escapement, the delayed-action cocking arm comes against the blade of the self-timer switch. The self-timer switch then connects to ground through the delayed-action cocking arm.

A pink wire from the self-timer switch goes to the top of the camera. In early models of the EL, the pink wire connects to the main circuit board, Fig. 76. The

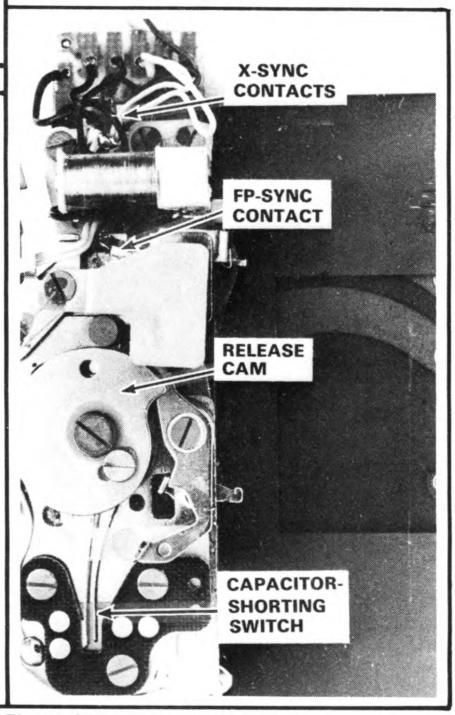


Figure 97

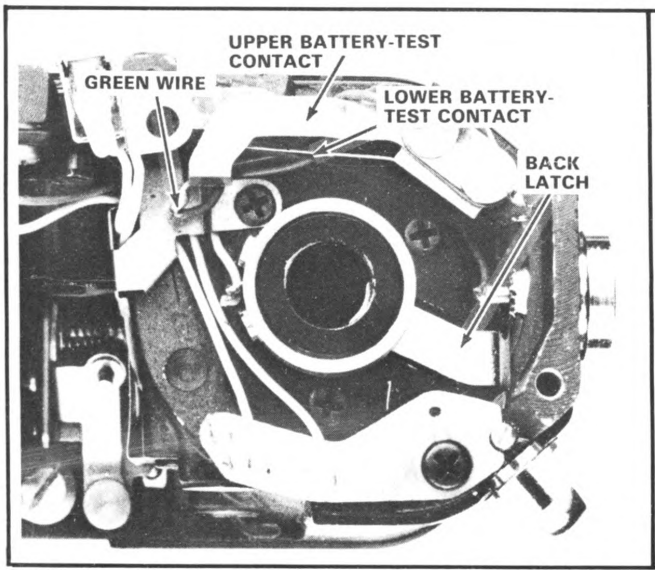


Figure 98

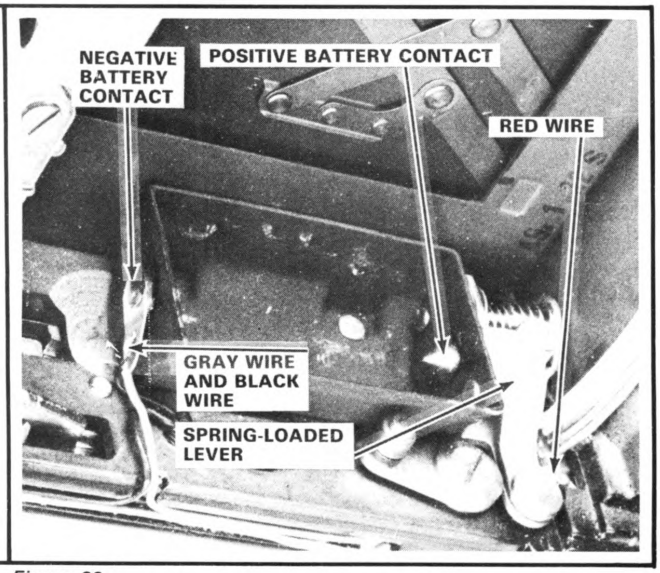


Figure 99

self-timer switch then provides a memory-hold feature when you're using the delayed action.

In later models, though, Nikon decided to allow the memory circuit to continue calculating the exposure during the delayed-action cycle. You may then find that the other end of the pink wire doesn't connect to anything. The pink wire may be cemented along the back of the camera (taking the same route as does the blue wire which goes to the flashcord terminal). But Nikon leaves the end of the pink wire disconnected. Consequently, there's one empty land on the main circuit board.

To remove the shutter assembly, first unsolder the blue flashcord wire from the back of the shutter circuit board, Fig. 92 (this is the wire that's cemented along the back of the camera). Then, take out the two screws at the top of the shutter-blade assembly. As is typical of cameras using the Copal Square, a third screw holds the shutter from the back. Open the camera back and remove the screw near the bottom of the focal-plane aperture. You can now lift out the shutter module, Fig. 95.

There's only one timing consideration on reassembly -- the timing between the main cocking gear segment, Fig. 96, and the rack on the cocking slide (the slide at the bottom of the camera). Start with the shutter in the released position. Then, rotate the main cocking gear segment to the position shown in Fig. 96. Here, the main cocking gear segment is against the end of the slot in the wind-gear sector. If you continue turning the main cocking gear segment in a counterclockwise direction, the wind-gear sector will cock the shutter.

In Fig. 97, we've removed the delayed-action escapement to more clearly show the capacitor-shorting switch. (Watch for the two loose spacers under the delayed-action escapement.) With the shutter released, Fig. 97, a nylon cam (under the release cam) holds open the capacitor-shorting switch. Cocking the shutter allows the capacitor-shorting switch to close, shorting across the timing capacitor.

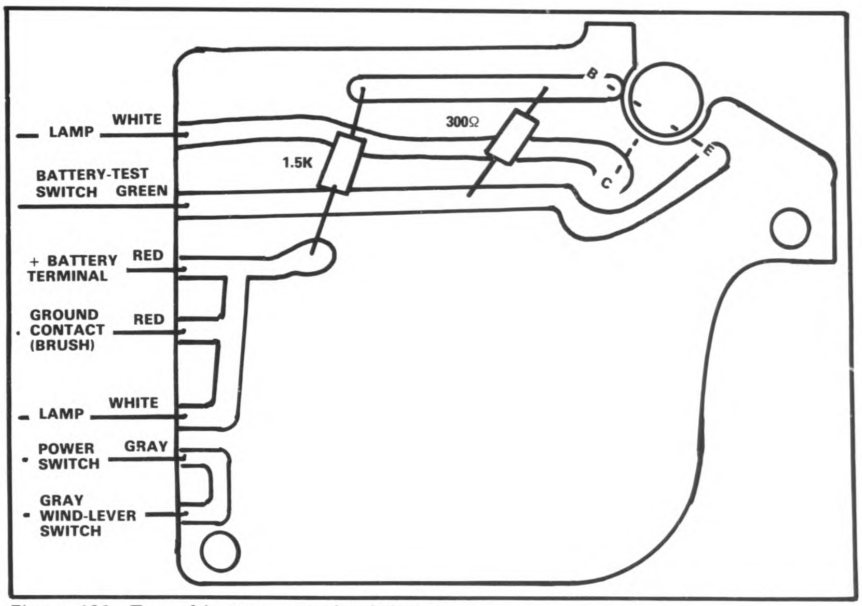


Figure 100 Top of battery-test circuit board

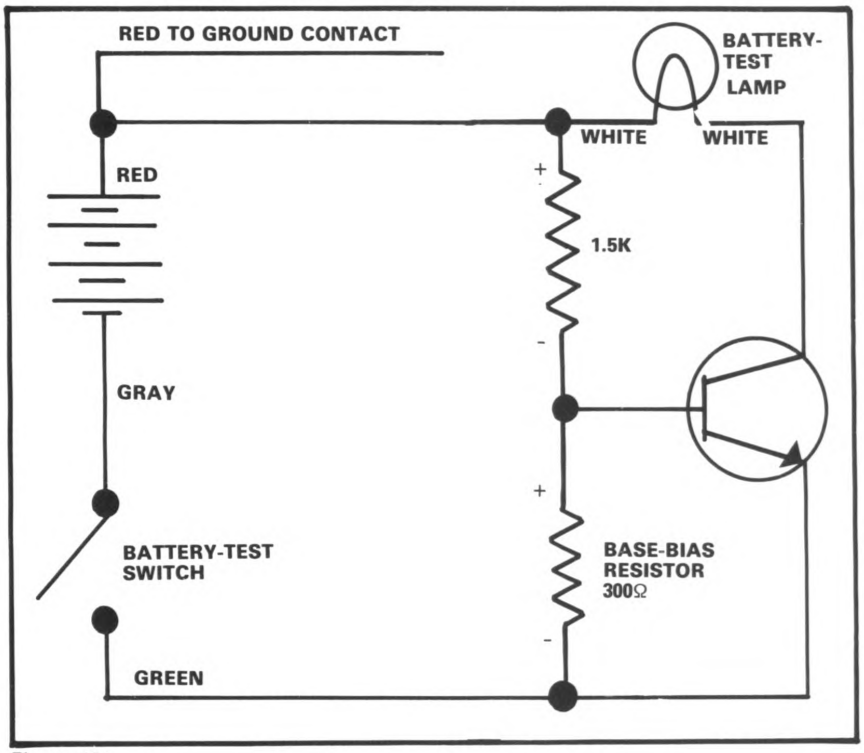


Figure 101

WIRING OF THE BATTERY-TEST CIRCUIT BOARD AND BATTERY COMPARTMENT

There seems to be only one "common" problem with the battery-test components -- a damaged battery-test button. You may then find that the green wire which connects to the upper battery-test contact, Fig. 98, has come loose. A gray wire connected to the lower battery-test contact goes to the negative terminal of the battery compartment, Fig. 99.

Notice in Fig. 99 that the negative terminal of the battery compartment has two wires -- the gray wire from the battery-test switch and a black wire which goes to the wind-lever switch. A red wire connected to the positive terminal of the battery compartment connects to the battery-test circuit board, Fig. 100.

Another red wire connects to the same land on the battery-test circuit board; this wire goes to the ground (wiper) contact that rides against the functional-resistor housing. Here, the battery-test circuit board just provides a convenient terminal for the two red wires. But the battery-test circuit board also contains the "brain" of the battery-test circuit. The transistor and the two resistors shown in Fig. 100 connect to the underside of the battery-test circuit board.

Fig. 101 shows the battery-test circuit. Closing the battery-test switch channels battery current through the two resistors at the underside of the battery-test circuit board. A sufficient voltage drop across the base-bias resistor turns on the transistor. The transistor then sends current through the battery-test lamp.

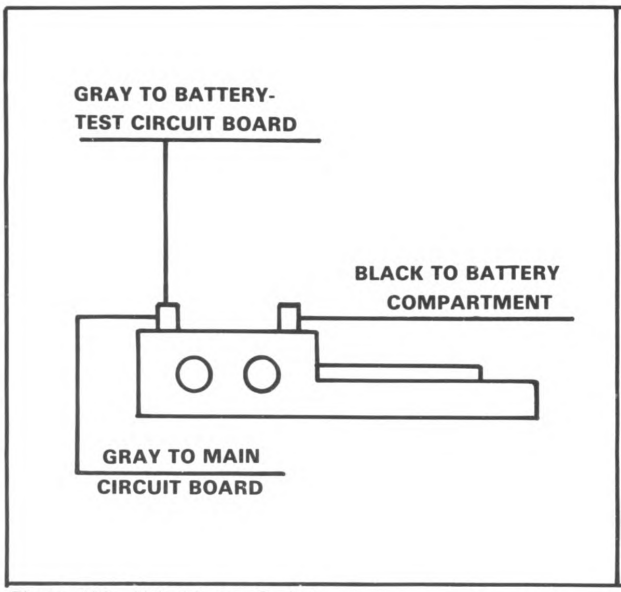


Figure 102 Wind-Lever Switch

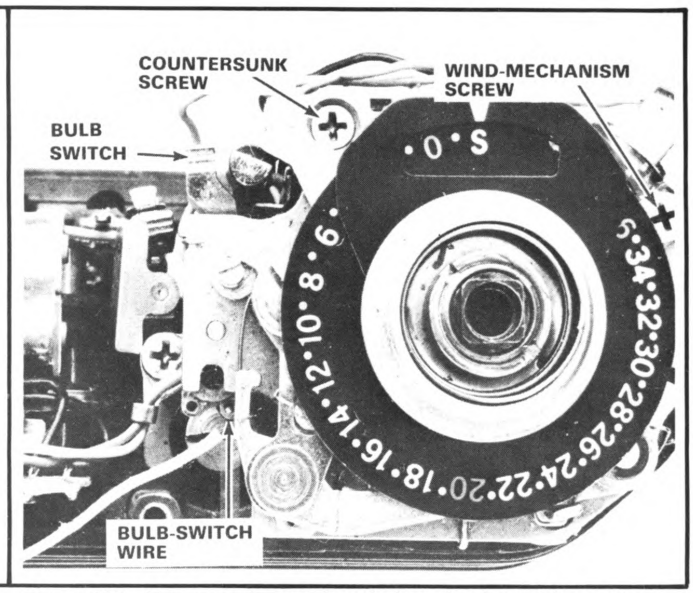


Figure 103 You can take out the wind mechanism without removing the wind lever. We've removed the wind lever in this illustration to point out the parts.

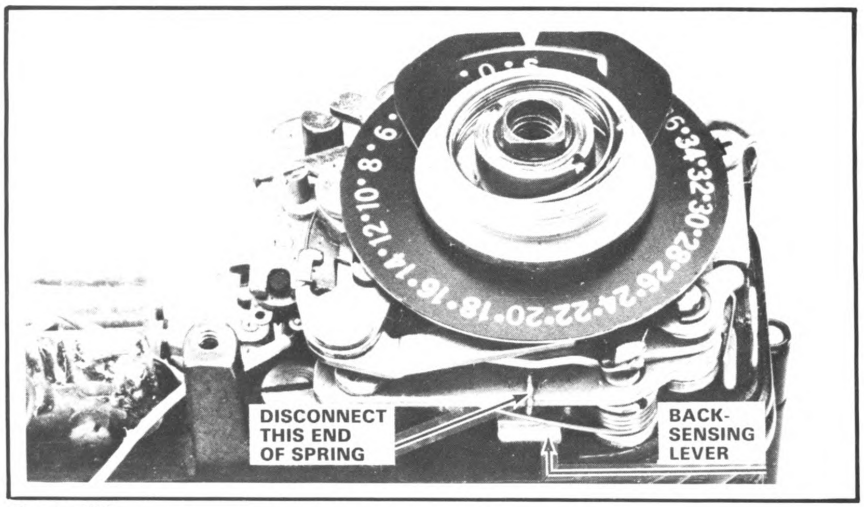


Figure 104

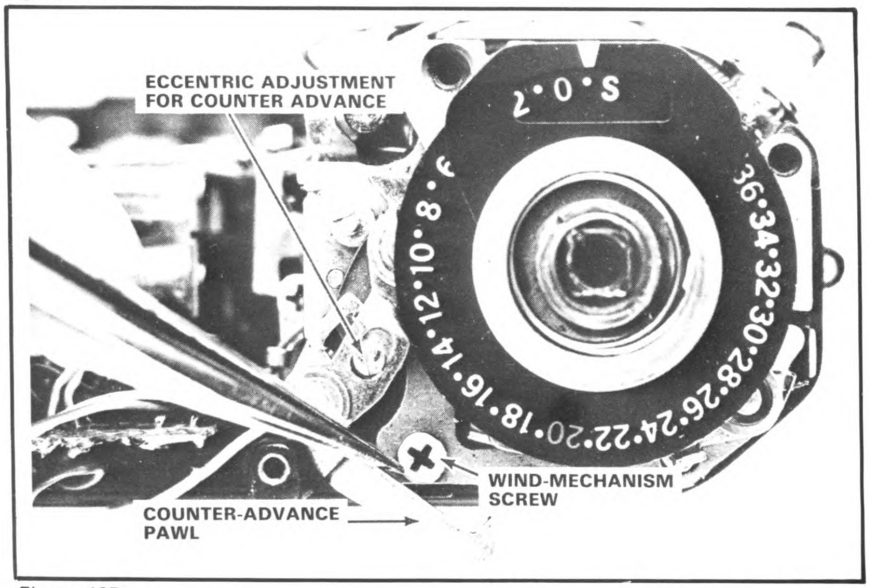


Figure 105

Before leaving the battery compartment, Fig. 99, we should point out one other feature thoughtfully provided by Nikon -- the movable positive battery terminal. A spring-loaded lever has the pointed contact which engages the battery. Pushing the lever from left to right moves the pointed contact out of the battery compartment.

The movable positive battery terminal makes it easy to remove and replace the battery. When you open the battery-compartment door, the positive battery terminal moves out of the way. The battery-compartment door just comes against a lever on the rewind side of the mirror cage. The lever then pushes aside the positive battery terminal.

REMOVING THE WIND MECHANISM

You can remove the wind mechanism as a unit to repair the release-button lock or the wind-lever switch. Replacing either the sprocket or the take-up spool also requires that you remove the wind mechanism.

First, unsolder the two gray wires and the black wire from the wind-lever switch, Fig. 102. Also unsolder one end of the white bulb-switch wire, either from the speed-selector board or from the bulb switch, Fig. 103. Since these illustrations show the front-plate/mirror-cage assembly removed, we've already disconnected the bulb-switch wire from the speed-selector board.

Looking at the back of the wind mechanism, locate the back-sensing lever, Fig. 104. When you open the camera back, the spring-loaded back-sensing lever pulls the counter-advance

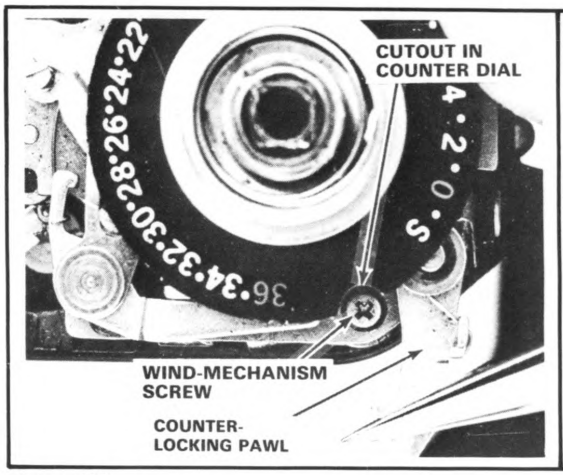


Figure 106

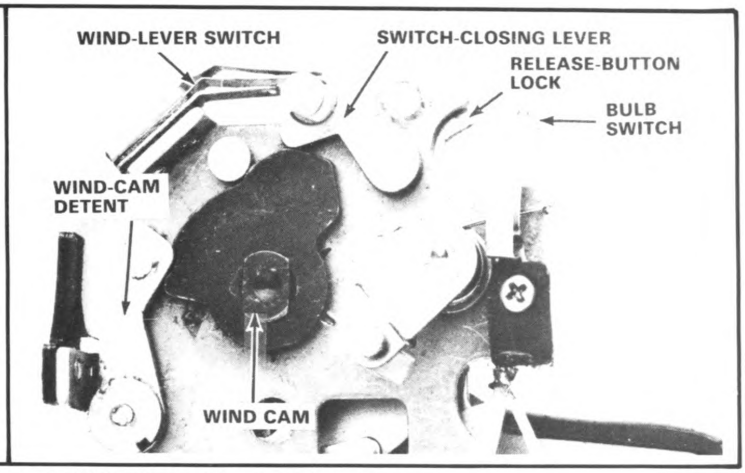


Figure 107 *Underside of wind mechanism*

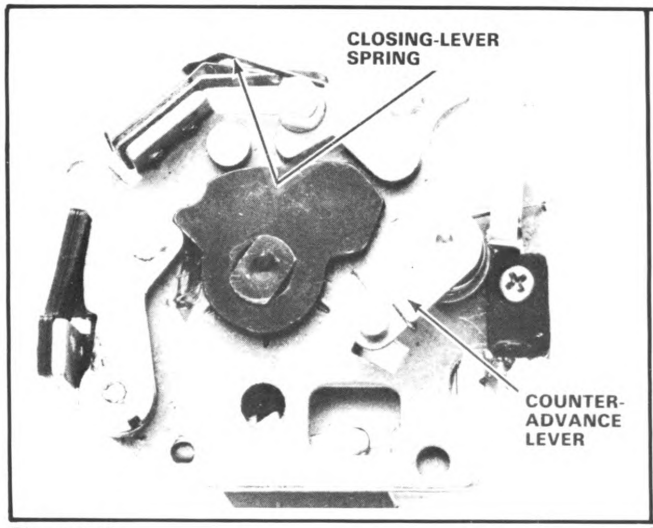


Figure 108

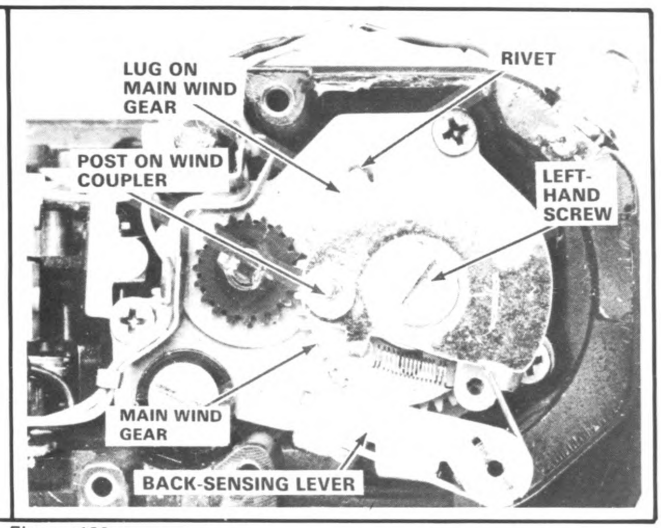


Figure 109

pawl and the counter-locking pawl away from the counter dial. The counter dial then returns to the "S" position.

Notice that the spring for the back-sensing lever connects to the wind-mechanism plate, Fig. 104. Disconnect the hooked end of the spring. Then, remove the two screws shown in Fig. 103. The other two screws holding the wind mechanism are hidden by the counter pawls.

Hold the counter-advance pawl against its spring tension to remove the third screw, Fig. 105. To reach the fourth screw, first open the camera back by pulling up the back latch, Fig. 98. Then, rotate the counter dial in a clockwise direction to the position shown in Fig. 106. While holding aside the counter-locking pawl, you can reach the fourth screw through the clearance cutout in the counter dial.

After removing the fours screws, lift off the wind mechanism. You can now see the switch-closing lever for the wind-lever switch, Fig. 107. With the wind lever in the storage position, Fig. 107, the wind cam pushes forward the switch-closing lever. And the switch-closing lever opens the wind-lever switch. The wind-cam detent, Fig. 107, holds the wind cam in the storage position.

When you move the wind lever to the ready position, Fig. 108, a spring pushes the switch-closing lever away from the wind-lever switch. The front blade of the wind-lever switch now moves against the back blade. At the same time, the release-button lock, Fig. 107, swings away from the release rod. The release-button lock attaches directly to the switch-closing lever.

The wind cam, Fig. 107, has a second purpose in the camera -- it advances the wind shaft. During the cocking cycle, the edge of the wind cam comes against the post on the wind coupler, Fig. 109. The wind cam drives the wind coupler in a counterclockwise direction.

You can now simulate the action of the wind cam to cock the shutter. Just turn the wind coupler in a counterclockwise direction. Since the wind coupler attaches to the upper end of the wind shaft, the cocking cam at the bottom of the camera also rotates. The cocking cam now draws the cocking slide in the direction that cocks the shutter.

At the same time, a pawl on the wind coupler engages one of the three lugs on the main wind gear, Fig. 109. The main wind gear drives both the sprocket and the take-up spool.

Notice in Fig. 109 that one of the lugs on the main wind gear is over the rivet on the mechanism plate. *With the main wind gear in this position, a pair of sprocket teeth should be pointing directly to the back of the camera.* The timing of the sprocket with respect to the main wind gear provides proper film registration; the spaces between film frames then align with the spaces between perforation holes.

As yet, you haven't disturbed the sprocket timing. But you'll lose the timing if you remove the main wind gear. To check the sprocket timing, disengage the transport latch and rotate the wind coupler in a counterclockwise direction. At the same time, use your thumb to ap-

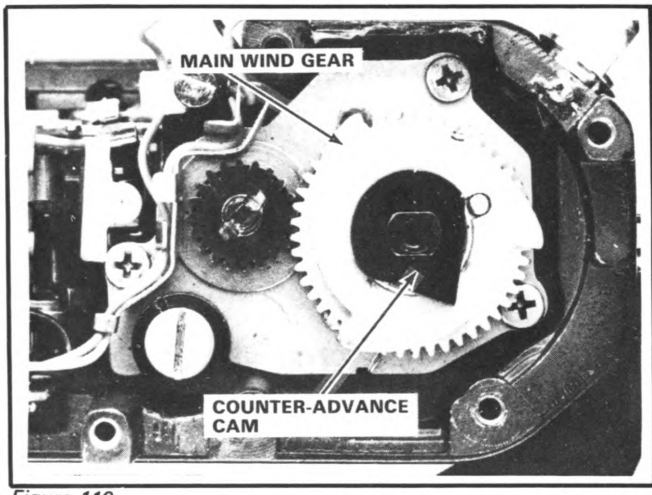


Figure 110

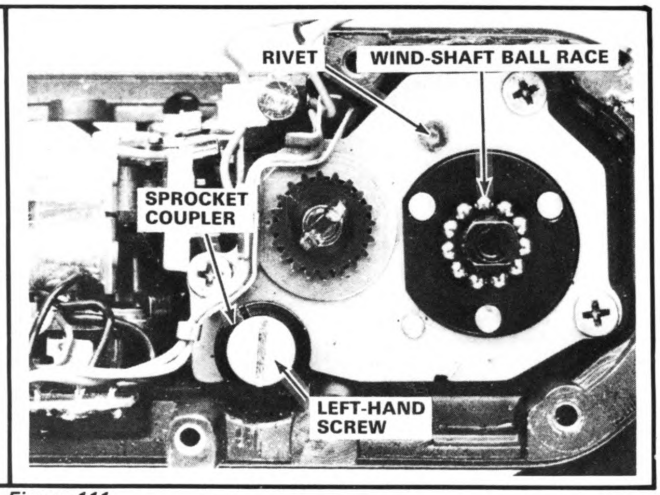


Figure 111

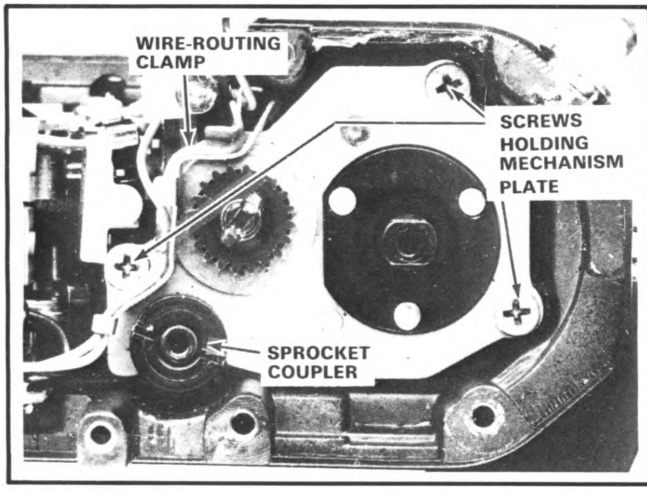


Figure 112

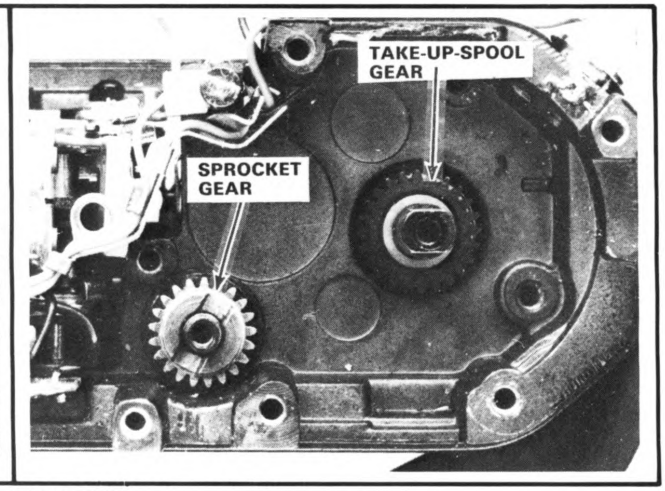


Figure 113

ply some pressure to the sprocket; the pressure simulates the action of the film. Then, after completing the cocking stroke, allow the wind coupler to return. One tooth on each sprocket should now be pointing directly to the back of the camera.

You'll have to remove the main wind gear -- and disturb the sprocket timing --to replace either the sprocket or the take-up spool. The screw holding the wind coupler has a left-hand thread. Take out the screw and lift off the wind coupler, Fig. 109. You might also get the back-sensing lever out of your way by removing its screw and spring, Fig. 109.

Now, lift off the counter-advance cam, Fig. 110. During the wind cycle, the counter-advance cam comes against the counter-advance lever, Fig. 108. The counter-advance lever then actuates the counter-advance pawl, turning the counter dial one film-frame calibration.

Be careful as you lift off the main wind gear, Fig. 110 -- there are 11 ball bearings around the wind shaft, Fig. 111. Lift out the individual ball bearings. The diameter of each ball bearing is 1.65mm.

Before replacing the main wind gear, rotate the sprocket until a pair of sprocket teeth point to the back of the camera. Then, seat the main wind gear with one of its lugs centered over the rivet, Fig. 111. After replacing the wind coupler, check the timing of the sprocket as previously described.

Next, unscrew the left-hand screw above the sprocket coupler, Fig. 111. The sprocket coupler has one downward-projecting tooth which engages one of two slots in the sprocket gear. When you push in the rewind button, the sprocket coupler moves up. The tooth of the sprocket coupler then clears the sprocket gear, allowing the sprocket to rotate in the reverse direction.

The sprocket coupler screws onto the upper end of the sprocket rod (the rod passing through the center of the sprocket). So, to unscrew the sprocket coupler, you must push up the sprocket rod; that disengages the tooth of the sprocket coupler from the sprocket gear. Push up the sprocket rod from the bottom of the camera and unscrew the sprocket coupler, Fig. 112. If you wish, you can temporarily replace the locking collar at the lower end of the sprocket rod; the sprocket rod will then latch in its raised position.

Now remove the three screws holding the mechanism plate, Fig. 112; notice that one of the screws also holds the wire-routing clamp. Lift out the mechanism plate and the two loose gears -- the sprocket gear and the take-up-spool gear, Fig. 113. The take-up spool gear includes the slip spring, Fig. 114. On reassembly, make sure you pass the tab of the slip spring through the slot in the take-up spool.

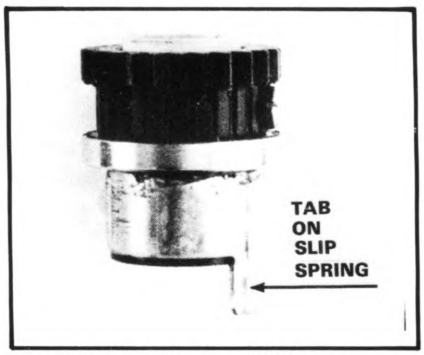


Figure 114 Take-up-spool gear

Continued next issue

evolution of the nikkormat el

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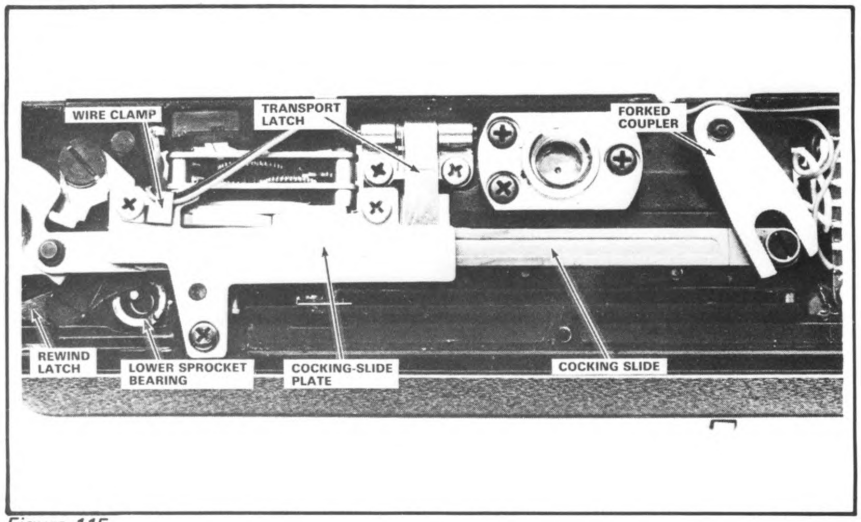


Figure 115

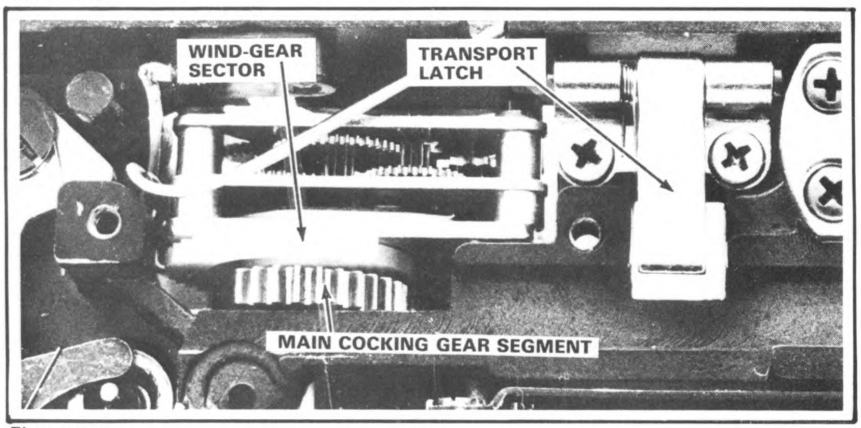


Figure 116

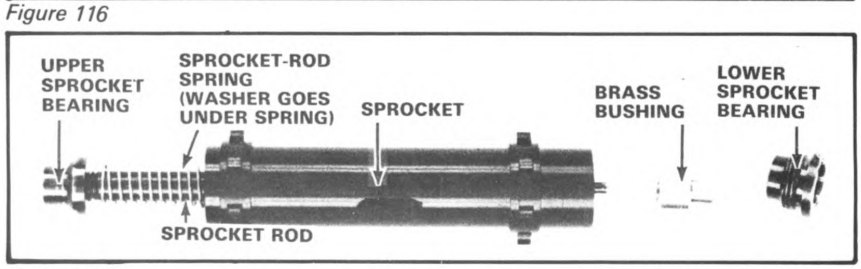


Figure 117

REMOVING THE SPROCKET

To remove either the sprocket or the take-up spool, you'll have to disassemble some parts at the bottom of the camera. Take out the screw holding the mirror-cage charge lever, Fig. 80. The charge lever mounts to the post of the forked coupler, the coupler which fits over the post on the cocking slide, Fig. 115. After removing the charge lever, you can lift out the forked coupler.

Next, take out the three screws holding the cocking-slide plate, Fig. 115. One of the screws also holds a wire clamp for the gray wire and the black wire which come from the wind-lever switch. Lift out the cocking-slide plate and the cocking slide.

Notice the roller on the underside of the cocking-slide plate; the roller rides against the edge of the cocking slide. Before replacing the cocking slide, make sure that the shutter is in the released position. Then, rotate the main cocking gear segment, Fig. 116, in a counterclockwise direction (as seen from the back of the camera). When the main cocking gear segment is against the wind gear sector, seat the cocking slide. As you replace the cocking-slide plate, push down the transport latch; the end of the transport latch passes under the cocking-slide plate.

If you're replacing the sprocket, there's just one more lever to get out of the way -- the rewind latch, Fig. 115. When you depress the rewind button, the rewind latch engages the locking collar; that holds the sprocket rod in the disengaged position. Disconnect the rewind-latch spring from the side of the rewind latch. Then, take out the shoulder screw and remove the rewind latch from the camera.

Removing the lower sprocket bearing, Fig. 115, may be the toughest part of the whole procedure. The lower sprocket bearing has a normal (right-hand) thread. But Nikon uses a generous amount of locking agent on the threads. You may have to use some solvent to loosen the locking agent.

Then, unscrew the lower sprocket bearing and lift out the brass bushing which serves as the lower sprocket pivot. When you replace the brass bushing, the larger diameter goes toward the sprocket.

Finally, remove the screw which passes through the slot in the sprocket. The screw threads into the sprocket rod. One end of the sprocket-rod screw hole has a flat surface. Before replacing the screw, rotate the sprocket rod until you can see the flat surface through the sprocket slot.

You can now lift out the sprocket rod toward the bottom of the camera. Then, working from the back of the camera, lift out the sprocket. Watch for the loose sprocket-rod spring and washer which go inside the sprocket; the loose upper sprocket bearing goes on top of the sprocket. Fig. 117 shows the reassembly sequence for the sprocket parts.

REMOVING THE TAKE-UP SPOOL

Nikon also applies a generous amount of locking agent to the screw holding the cocking cam, Fig. 118. But you don't have to remove the cocking cam; you can take out the complete wind shaft as a unit.

It helps to first get two other levers out of the way -- the wind pawl and the release-rod lock, Fig. 118. The wind pawl rides against the teeth of the wind ratchet, Fig. 118. If you stop advancing the wind lever before the end of the wind stroke, the wind pawl prevents the wind shaft from returning.

At the end of the wind stroke, the wind pawl drops into the wind-ratchet cutout as shown in Fig. 119. The spring-loaded wind shaft then returns to its starting position. Notice that the lug on the wind ratchet permits a forming adjustment; you can change the size of the gap, Fig. 119, to adjust the width of the lug. Suppose, for example, that the wind ratchet

fails to drop into the wind-ratchet cutout at the end of the cocking cycle. And, as a result, the wind shaft can't return to its starting position. You can then decrease the width of the gap, Fig. 119, by squeezing together the wind-ratchet lug.

To remove the wind pawl, first disconnect the tension-type spring -- disconnect the end of the spring that hooks to the wind-pawl hole, Fig. 119. You can leave the other end of the spring connected to the brass spring-hooking screw. Then, take out the shoulder screw and remove the wind pawl.

The second lever -- the release-rod lock -- prevents you from pushing down the release rod during the wind stroke. As you cock the shutter, the edge of the cocking cam comes against the tab on the release-rod lock, Fig. 119. The cocking cam then pushes the release-rod lock in a counterclockwise direction. Now, the edge of the release-rod lock passes into a notch in the release rod.

Disconnect the end of the spring from the tab on the release-rod lock. Lift out the spring and remove the shoulder screw. You can then remove the release-rod lock from the camera.

If you now rotate the cocking cam in a clockwise direction, you can feel the tension of the wind-shaft spring. The wind-shaft spring seats around the wind shaft. One end of the wind-shaft spring hooks to the wind shaft; the other end hooks to the slot in the spring-hooking plate, Fig. 119.

A lug on the body casting, Fig. 118, limits how far the cocking cam can rotate in a counterclockwise direction. But you can let off the initial tension by lifting the cocking cam until it clears the stop lug. Lift the cocking cam away from the camera body and allow the wind-shaft spring to turn the wind shaft counterclockwise.

For reassembly reference, note the position of the slot in the spring-hooking plate. Then, take out the three screws which hold the spring-hooking plate. You can reach the screws through the cutout in the wind ratchet. Just rotate the cocking cam until the cutout is above one of the screws. Remove the screw through the cutout. Then, rotate the cocking cam until the cutout is over the next screw.

After removing the three screws, you can lift out the complete wind shaft, Fig. 120. Then, lift out the take-up spool from the back of the camera.

Apply the initial tension to the wind-shaft spring after replacing the wind shaft. Rotate the spring-hooking plate until its slot is in the position you noted prior to disassembly and replace the three screws. Now, rotate the cocking cam in a clockwise direction to apply the initial tension. Turn the cocking cam until it comes against the stop lug on the body casting. Then, lift the cocking cam up and over the stop lug. The cocking cam should now be positioned as shown in Fig. 118 with the initial tension on the wind-shaft spring.

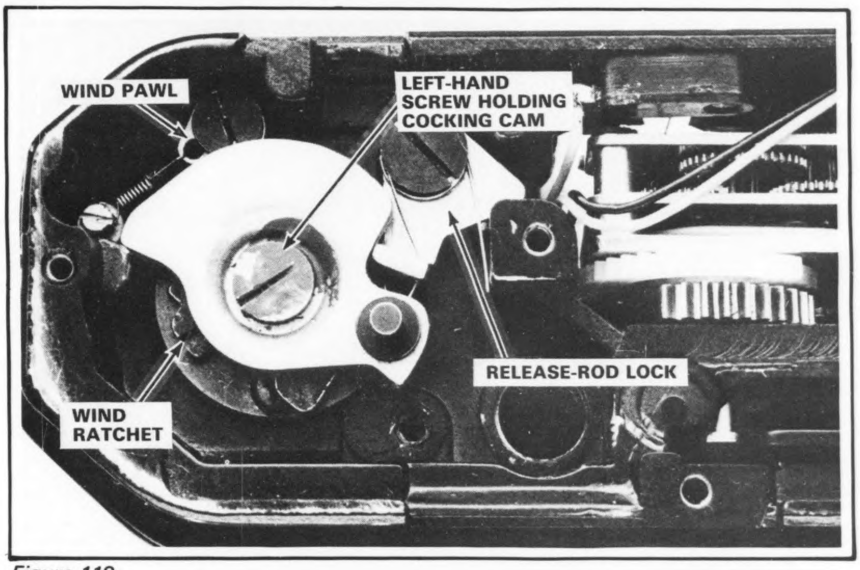


Figure 118

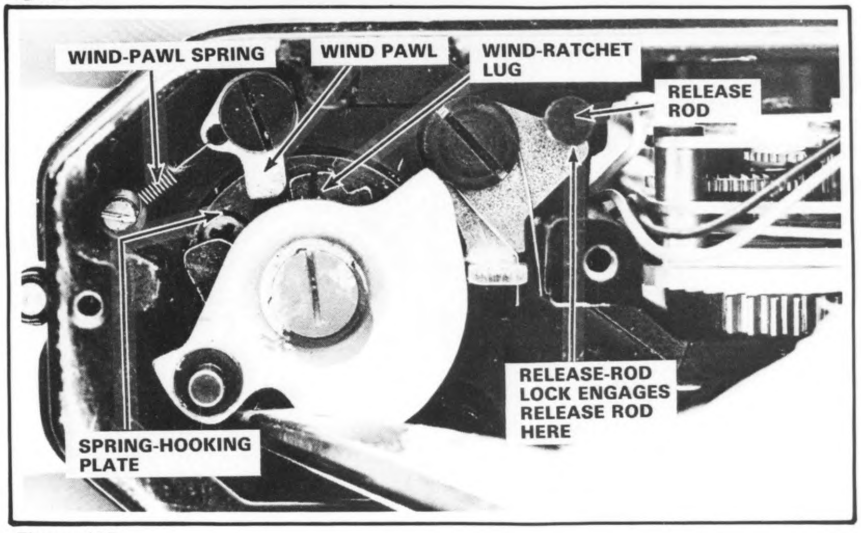


Figure 119

REPAIRS ON THE MAIN CIRCUIT BOARD

Earlier, we mentioned that you can get individual replacement components for the main circuit board. In some cases, you can usually save time and money by replacing components. However, if the problem points to a defective IC, you're probably better off replacing the complete circuit board.

The replacement IC costs a lot less than does the complete main circuit board. But replacing an IC takes quite a bit of time. Regardless of which route you take, you must unsolder the wires, Fig. 121, and remove the main circuit board.

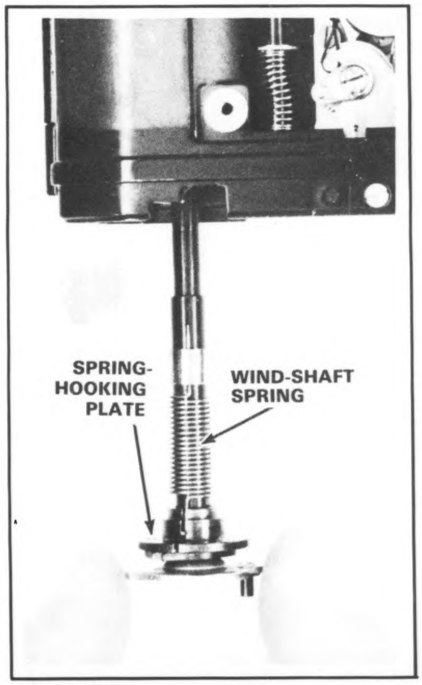


Figure 120

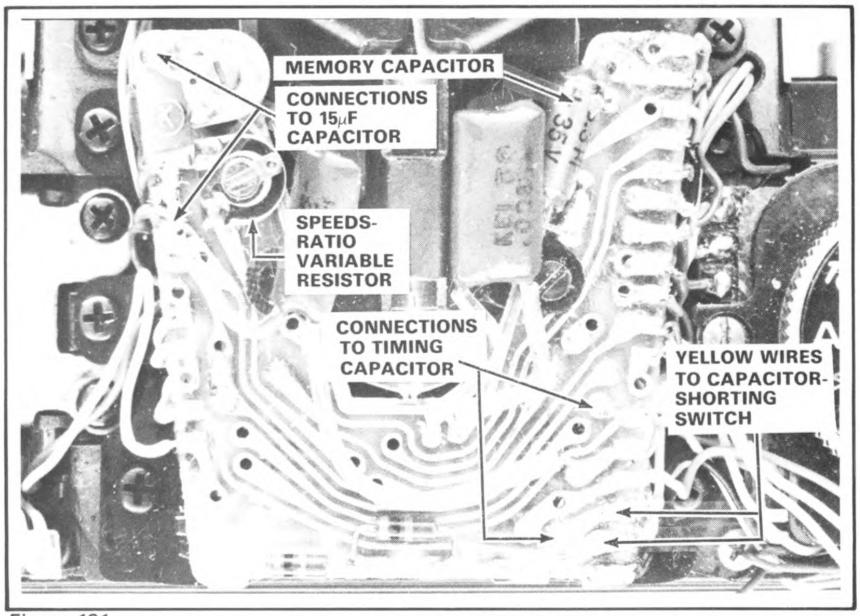


Figure 121

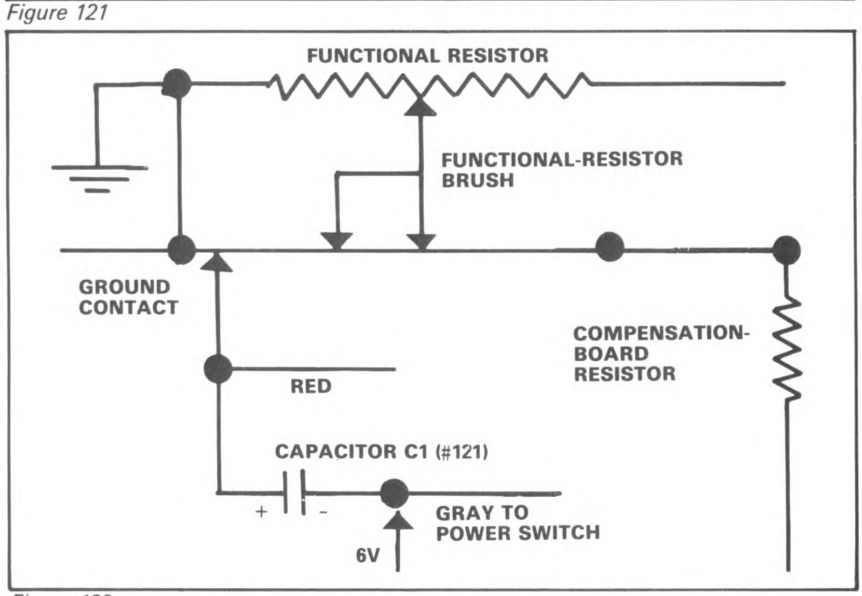


Figure 122

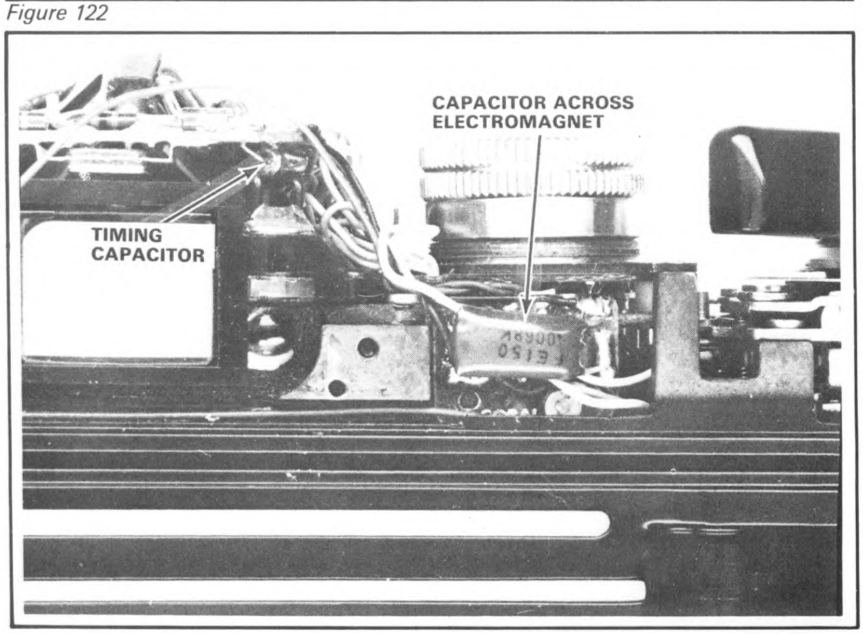


Figure 123

Also, the factory calibrates the speeds-ratio variable resistor to the individual IC, Fig. 121. So, if you replace the complete circuit board, you should not have to disturb the adjustment. As mentioned earlier, the speeds-ratio variable resistor affects both exposure modes -- automatic and manual.

What if you do have to make the adjustment? You can then consider the speeds-ratio variable resistor to be a linearity control. By contrast, the auto-speeds adjustment and the manual-speeds adjustment provide total-response controls.

If necessary, adjust the speeds-ratio variable resistor until you have the same exposure error under a high light level as you do under a low light level. Then use the auto-speeds adjustment to correct the error.

Consider, for example, that you're using the camera settings of ASA 100 and f/5.6. At EV14, you should get an automatic exposure of 1/500 second. The exposure at EV9 should be 32 times slower than the exposure at EV14 -- 1/15 second.

So, to set the speeds ratio, adjust the speeds-ratio variable resistor until the exposure at EV9 is 32 times slower than the exposure at EV14. And adjust the auto-speeds variable resistor until the shutter delivers an accurate 1/15 second at EV9.

Alternately, you can adjust the speeds-ratio variable resistor for the manually set shutter speeds. Compare the exposure at the 1-second setting with the exposure at the 1/1000-second setting. Adjust the speeds-ratio variable resistor for the same amount of error at both settings; then use the manual-speeds variable resistor to correct the error. Remember to check the exposure at 1/125 second also; here you want the flash-sync speed of 1/90 - 1/100 second.

Yet you can replace the other components without disturbing factory adjustments. Consider that *the shutter delivers the mechanical speed only --regardless of the speed-knob setting.* This malfunction may indicate a shorted capacitor C1, Fig. 122. Fig. 121 shows the connections of the 15μF capacitor.

Notice in Fig. 122 that the capacitor connects to the power switch. If the capacitor is shorted, it places a direct short between the power switch and ground. As a result, the shutter will only deliver the mechanical speed.

You can use an ohmmeter to check for a short across the capacitor. Or you can use a voltmeter. With a voltmeter connected across the capacitor, you should measure 0 volt before you release the shutter. But the voltage should reach 6 volts when the power switch closes (just

before the mirror-lifting lever strikes the mirror-bracket pin).

Another capacitor that can fail is the 3.3μF memory capacitor, Fig. 121. A shorted or open memory capacitor *causes the shutter to hang open at the automatic setting.* But the camera still works properly at the manually set shutter speeds.

When checking the memory capacitor using a voltmeter, you should measure 0 volt until you close the wind-lever switch (by pulling the wind lever away from the camera body). The voltage across the memory capacitor should then increase as the light level increases. As you change the amount of light striking the photocells, the voltage should vary within a range of around 1.5 volts to 1.8 volts.

A third capacitor -- the 1μF timing capacitor -- mounts to the underside of the main circuit board, Fig. 123. If the timing capacitor is defective, *the shutter will hang open at all settings -- manual or automatic.*

With the shutter cocked, you should measure 0 volt across the timing capacitor. The capacitor-shorting switch now shorts across the timing capacitor, preventing any charge. But, when you release the shutter, you should see the timing-capacitor voltage increase. A sufficient charge on the timing capacitor tells the IC to shut off the current flowing through the electromagnet.

A shorted capacitor-shorting switch causes the same problem as does a shorted timing capacitor -- the shutter hangs open, regardless of the speed setting. As mentioned earlier, you can check the capacitor-shorting switch from the top of the main circuit board. Just disconnect one of the yellow wires, Fig. 121. Then, use an ohmmeter to check between the disconnected yellow wire and the other yellow wire at the main circuit board. When the shutter is cocked, you should read continuity. But you should read an open circuit after you release the shutter.

Also, check for continuity across the capacitor-shorting switch when both yellow wires are soldered to the main circuit board. You may just have a solder bridge connecting the two circuit-board lands, Fig. 121. The effect is then the same as that of a constantly closed capacitor-shorting switch.

Fig. 123 shows one more capacitor you may have to replace -- the capacitor that connects in parallel with the electromagnet. If the capacitor is shorted, it places a short across the electromagnet in the shutter. The shutter then delivers the mechanical speed only, regardless of the speed-knob setting. Why? Because no current flows through the electromagnet.

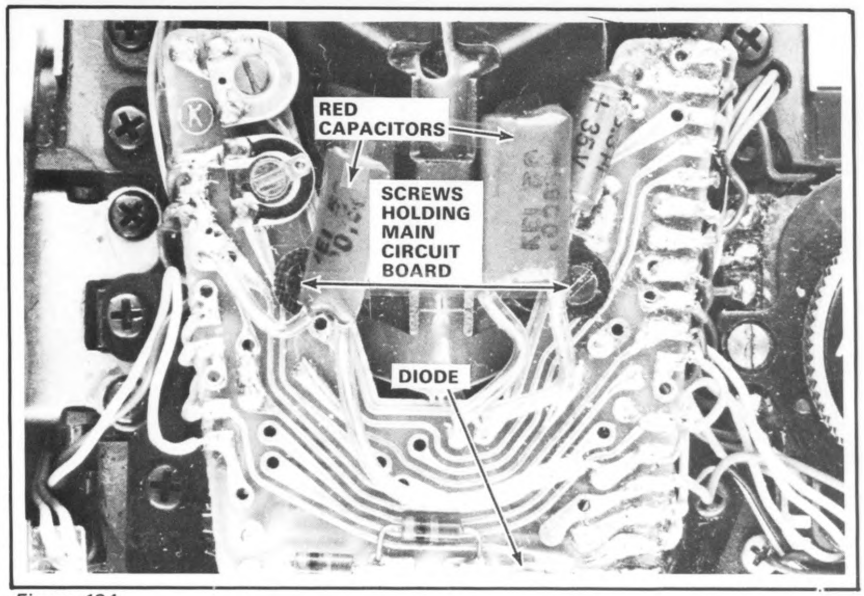


Figure 124

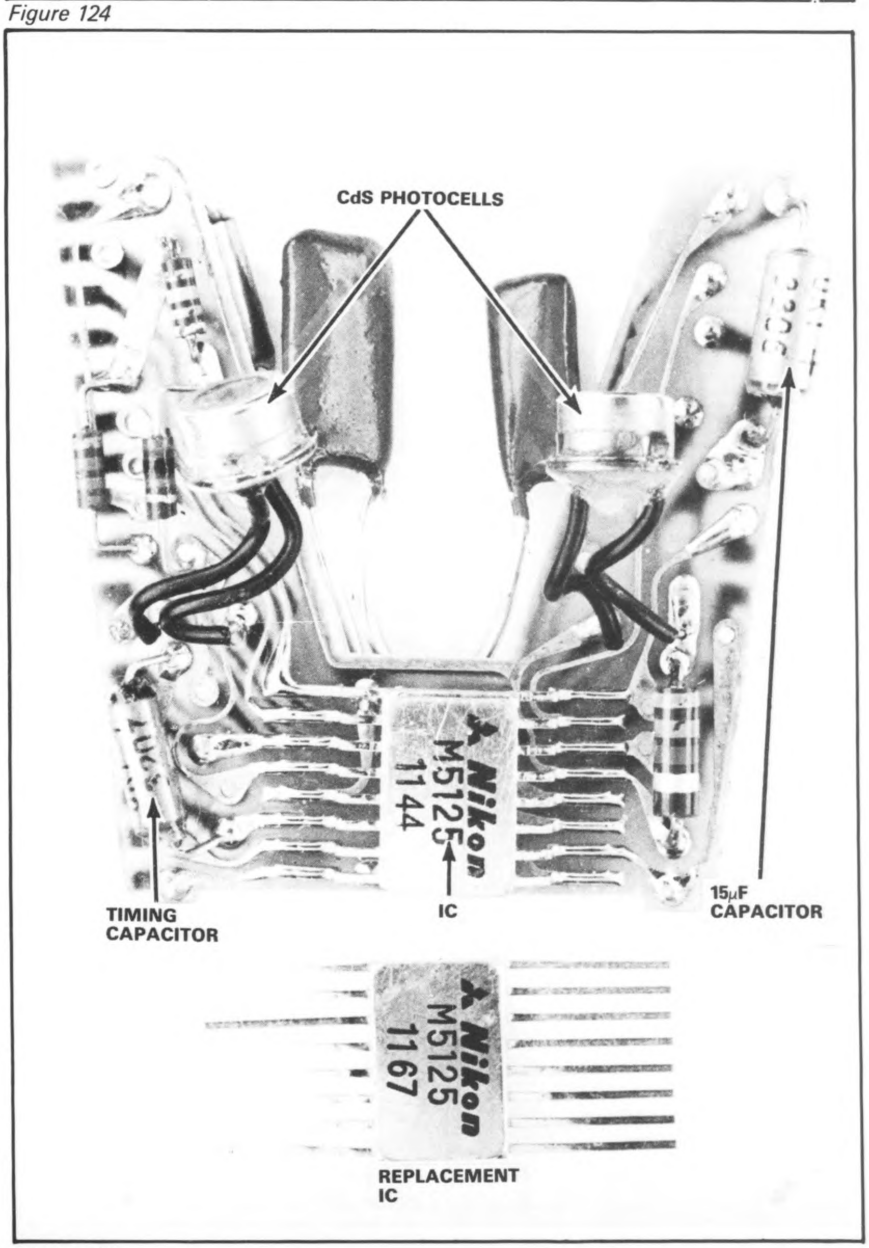


Figure 125

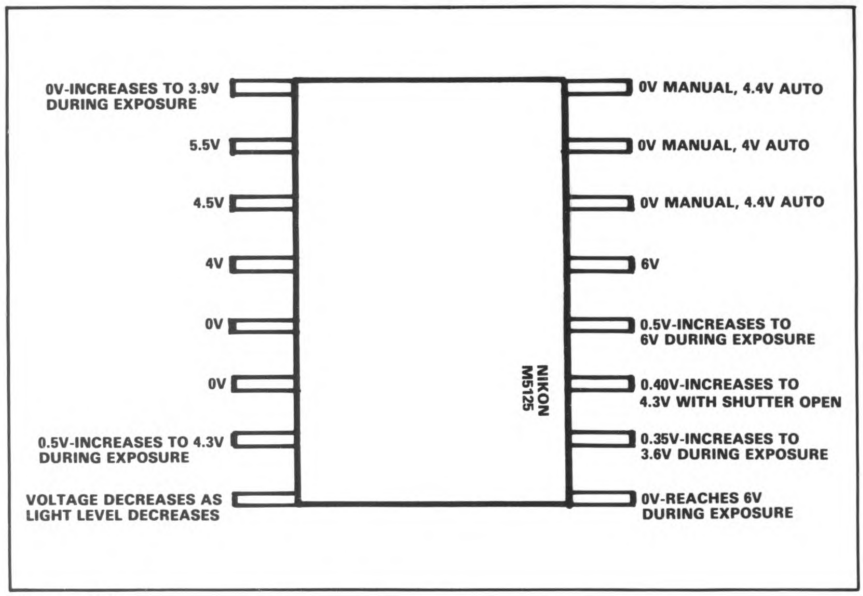


Figure 126

You can quickly check the electromagnet capacitor by disconnecting one of its leads. If the shutter now works, you know that the capacitor has a short. It's possible that you already have a supply of replacement components for the electromagnet capacitor -- providing you've had occasion to replace a main circuit board. You can then use one of the red capacitors at the top of the old board, Fig. 124, as a replacement.

Here's another possible cause of the shutter's delivering the mechanical speed only -- the diode, Fig. 124, is open. An open diode breaks the current path for the electromagnet.

What we've been describing really amounts to troubleshooting by the process of elimination -- eliminating the possible causes of a malfunction to reach the IC. There always seems to be a tendency to replace the main circuit board at the first indication of an electronic malfunction. But replacing the main circuit board may not correct the problem -- not if the problem is in the functional resistor, the speed selector, or the electromagnet.

However, if your troubleshooting leads you to the IC, your fastest repair is to replace the main circuit board. Remove the main circuit board by first unsoldering the wires, Fig. 124. The pictorial, Fig. 76, shows the positions of the wires for reassembly reference. But, as always, be on the alert for variations in color coding or wire positions.

Notice in Fig. 76 that there are two pink wires on the wind-lever side of the main circuit board; be careful to avoid interchanging the positions of these two wires. One of the pink wires goes to the self-timer switch (this is the wire that may not be connected in your camera). The other pink wire goes to the auto/manual switch.

Now, take out the two screws, Fig. 124. Watch for the insulator washers under the screws and under the main circuit board. The two photocells are cemented to the tops of the photocell prisms on the eyepiece assembly. So, as you lift off the main circuit board, you'll have to pry loose the photocells.

Fig. 125 shows the underside of the main circuit board along with a replacement IC. Here, you can visualize the problems involved with soldering a new IC to the main circuit board -- those pins sit very close to one another. The pictorial of the IC, Fig. 126, shows the voltages measured to the pins in our evaluation camera; these are the voltages of a properly operating IC with all the wires connected.

CONCLUSIONS ON THE EL

The modular construction of the Nikkormat EL speeds up troubleshooting and repair. Still, there's one drawback to the modular design -- replacement modules are expensive. Before replacing a main circuit board, remember to check the other possible causes of a particular symptom.

To sum up some of the more common checkpoints, consider that the shutter delivers only the mechanical speed when set to automatic. And the needle always shoots to the top of the focusing screen when you turn on the meter. Make your first test on the functional resistor.

Having a choice between manual and automatic settings helps isolate a malfunction. If the shutter hangs open when set to automatic -- but works properly at the manual settings -- suspect the

memory switch and the memory capacitor. Neither of these components has any function at the manual settings. Also suspect the memory switch if you're getting erratic exposures at the automatic function.

By contrast, the power switch affects both the automatic exposures and the manually set exposures. A defect in the power switch normally causes the shutter to deliver the mechanical speed only --regardless of the speed-knob setting.

So, if you're only getting the mechanical speed, make the power switch your first suspect. Other possibilities include an open electromagnet or a shorted capacitor on the main circuit board (the 15μF capacitor).

A defective power switch, though, wouldn't affect the needle readout. If the needle remains centered, and you only get the mechanical speed, the problem may be in the wind-lever switch or the battery connections. Check for the battery voltage at the main circuit board.

Now, consider the opposite malfunction -- the shutter hangs open, regardless of the speed-knob setting. Since you get the same malfunction at the manual settings as you do at the automatic setting, you know the problem can't be in the memory circuit. And, if the needle reads properly, there's no problem with the functional resistor. The logical suspects are the electromagnet and the capacitor-shorting switch.

What if the shutter only hangs open at the manual settings? Then, the problem may be in the speed selector. If you're not getting the needle readout -- yet the shutter works properly at all settings -- the speed-selector assembly may again be at fault. Most likely, the galvanometer is defective; a defect in the galvanometer means you must replace the complete speed-selector assembly.

We've never been able to get a schematic that shows exactly what's going on inside the IC. So, rather than starting with the IC as the suspect, we've tried to eliminate other possible causes of a problem. Then, as a last resort, you may have to replace the main circuit board. But don't throw away the old board; you can often use the components for other EL repairs.

Since the EL proved to be so popular, we'll no doubt be seeing the cameras for many years. But, in the present marketplace, the EL has one drawback --its size. Despite all the features and advantages, the EL had to move aside for the supercompact Nikon SLR's. The semiautomatic Nikon FM and the fully automatic Nikon FE represent the next steps in the evolution of the Nikkormat EL.

SUMMARY OF EXPOSURE ADJUSTMENTS

1. Rotational position of functional resistor

Set f/2 light level (EV 9).
f/5.6
ASA 100
Meter should read 1/15 second.

Set f/11 light level (EV 14).
ASA 25
f/16
Meter should read 1/15 second.

Rotate the functional-resistor element until the needle reads as close as possible to 1/15 second under both lighting conditions.

2. Viewfinder-readout adjustment

Set f/11 light level (EV 14)
f/5.6
ASA 100

Adjust the viewfinder-readout variable resistor until the needle reads 1/500 second.

3. Speeds-ratio adjustment

Normally, it's not necessary to disturb the speeds-ratio variable resistor. Check the adjustment by testing the automatically controlled exposure under a high light level and under a low light level. If necessary, adjust the speeds-ratio variable resistor for the same amount of error under the two lighting extremes. Alternately, you can adjust the speeds-ratio variable resistor at the manually selected shutter speeds. Make the adjustment for the same error at a fast speed as you get at a slow speed.

4. Auto-speeds adjustment

Set f/2 light level (EV 9).
Auto
f/5.6
ASA 100

Adjust the auto-speeds variable resistor for an automatically controlled exposure of 1/15 second.

5. Manual-speeds adjustment

Adjust the manual-speeds variable resistor for an exposure of 1/90 - 1/100 second at the 1/125-second setting.

6. Capacitor-shorting-switch adjustment

Check the 1/500-second and 1/1000-second shutter speeds. If necessary, turn the eccentric on the capacitor-shorting switch to bring in these speeds without affecting the other shutter speeds. The adjustment on the capacitor-shorting switch also affects the fast exposures at the automatic setting.